JOURNAL
OF THE
AMERICAN CERAMIC SOCIETY

A · MONTHLY · JOURNAL · DEVOTED · TO · THE · ARTS · AND · SCIENCES
RELATED · TO · THE · SILICATE · INDUSTRIES

ABSTRACTS
VOL. 12 No. 5

BULLETIN
VOL. 12 No. 5

VOLUME 16 MAY · 1933 NUMBER 5

Founded 1869

B. F. DRAKENFELD & CO. Inc.

45-7 Park Place New York

Chemicals for Glass Decolorization

GLOBE
DECOLORIZING COMPOUNDS

No. 1 Standard (with Cobalt)
No. 2 Special (without Cobalt)

Efficient — Economical — Reliable

SELENIUM—SODIUM SELENITE

COBALT OXIDE—POWDER BLUE

CAUCASIAN
MANGANESE DIOXIDE

Powdered—Granular—Pea Size

How is your stock of LABORATORY WARE?

for Ignition, Incineration, Filtration

NORTON REFRACTORIES

NORTON COMPANY

Worcester, Mass.

New York Chicago Cleveland

R-455A

ALUNDUM Laboratory Ware is characteristically strong, has high heat transfer properties and long life. Cleaning is a simple process of washing and igniting to constant weight.

There are tubes, cores and muffles for electric furnaces. Crucibles and dishes for igniting, incinerating and melting.

Dishes, cones, discs, thimbles and crucibles for filtering. Combustion boats, pyrometer tubes and refractory cements.

A great variety of standard sizes and shapes are carried in stock for immediate shipment.

A catalog describing Norton Laboratory Ware will be sent upon request—no obligation.

Of Value to You
is our
Long Record
of
Plant Proven Dependability
for
Constancy in Quality
due to
Laboratory Controlled Inspection
and
Nature's Most Uniform Deposits
of
Ball, Sagger, Enamel, Wad and Fire CLAYS

Mined and Sold by

KENTUCKY-TENNESSEE CLAY COMPANY

Mayfield, Kentucky

The Journal of the Society of Glass Technology

A quarterly Journal containing original papers and abstracts of papers covering the whole field of Glass Technology.

ANNUAL SUBSCRIPTIONS TO SOCIETY (Including "Journal")

Ordinary Members.....£1. 10. 0
Collective Members.....£3. 3. 0
Non-Members.....£2. 0. 0

Forms of application for membership may be obtained from the American Treasurer of the Society, Francis C. Flint, B.S., Washington, Pa.

Address orders and inquiries:
The Secretary,
Society of Glass Technology,
The University, Sheffield, England

ATTENTION

1. **Are you out of a job?**
2. **Would you like a new job?**
3. **Are you looking for a high class man to fill some vacancy?**

Our Classified Advertising rates are 35 words for $1.00

U. S. A. stands for the country we love best.

E. P. K. stands for the clay mined in U. S. A. that serves you best.

EDGAR PLASTIC KAOLIN CO.
Home Office—Metuchen, N. J.

EDGAR BROTHERS CO.
New York Office—50 Church St.

Mines in Georgia and Florida

(When writing to advertisers, please mention the JOURNAL)

Table of Contents

MAY, 1933

The Journal

Dust Elimination in the Pottery Industry—Schramm 205
Selenium Ruby Glass: Preparation and X-Ray Study—Bigelow with Silverman .. 214
Stresses in Domes and Crowns of Circular Kilns—Goodier 220
A Low-Temperature Comparator for Coefficient of Expansion of Ceramic Bodies—Davis 229
Mechanics of Enamel Adherence, VIII: (A) Apparatus for Firing Enamels under Accurate Control of Temperature, Pressure, and Atmosphere; (B) Studies in Firing Enamels under Reduced Pressures—King 232
A New Lepidolite Deposit in Colorado—Eckel 239
Strength and Durability Tests of Mortar-Mix Mortar—Spangler 246

Ceramic Abstracts 177

The Bulletin

Editorials
Buy American and Give Americans Work—Odhner 121
The Silicosis Racket 127

Papers and Discussions
Preparation of Thin Sections of Friable Material—Hite 135
Manufacturing Control of Dry-Pressed Porcelain—Cermak and Thiess 138

Activities of the Society
Excerpts from Minutes of the Board of Trustees Meetings, Pittsburgh, February 12–17, 1933 141
Our 1934 Annual Meeting 142
1933 Summer Meeting, American Ceramic Society at the Century of Progress Exposition, Chicago, Ill., Week of June 25 143
Report of the Research Committee of the Enamel Division for the Year 1932–1933 144
Proposed Amendment to Enamel Division By-Laws 146
Clay Plant Economies. Progress Report of the Technical Committee, No. 11, at the National Brick Manufacturers Research Foundation 146
Local Section News: Baltimore-Washington Section and Pittsburgh Section 153
Necrology: Charles W. Crane 154
New Members Received in March 154
Roster Changes in February and March 155
Glass Division Collaborated 155

Notes and News
Ceramic School Notes:
New York State College of Ceramics 156
America's Only Ceramic College, New York State College of Ceramics, Alfred, N. Y. 157
The Fourteenth Exposition of Chemical Industries 158
Owens-Illinois Exhibit at Chicago's Century of Progress Exposition 158
Our Past-President Poste 159
International Congress of Glass and Ceramics 159

Advertisers' Index 13

Publication Office: 20th & Northampton Sts., Easton, Pa.
Editorial and Advertising Offices: 2525 N. High St., Columbus, Ohio.
Executive Office: 2525 N. High St., Columbus, Ohio.
Committee on Publications: L. NAVIAS, *Chairman;* L. J. TROSTEL, M. F. BEECHER, R. M. KING, ROSS C. PURDY.
Entered as second-class matter at the post office at Easton, Pa., under the Act of March 3, 1879.
(Copyright 1933, American Ceramic Society)
Subscription Twelve dollars a year. Single numbers one dollar
(Foreign and Canadian postage, 50c additional on subscriptions)

"I'll call you up!"

A HUSBAND bids his wife good-bye as he leaves in the morning. "I'll call you up," he says reassuringly. A guest leaves after a pleasant week-end. "I'll call you up," she tells her hostess. An executive sits at his desk. "I'll call you up," he answers many times a day.

"I'll call you up" is a phrase that has become part of our language and part of our modern security. It is a phrase of confidence and a phrase of friendship. Implied in it is a nearness to everything and everybody.

The familiar gesture of lifting the telephone receiver holds boundless possibilities. It may avert a danger, end an anxiety, insure an order. Or it may be for some trivial pleasant purpose —a jest to be shared, a greeting to be spoken.

Over the telephone speed the thoughts and ideas that change destiny, bring new hope to the wondering and greater achievement to the ambitious. Think what this world would be like if you could not telephone so easily to so many people. No friend or place is far away when you can say—"I'll call you up."

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

(When writing to advertisers, please mention the JOURNAL)

DUST ELIMINATION IN THE POTTERY INDUSTRY*

By Edward Schramm

ABSTRACT

Dust counts were made in different parts of a pottery with and without natural and induced ventilation. The hoods installed at the benches of the finishers and setters and the remodeled stoveroom air-circulating system are described and illustrated. The effectiveness in reducing the dust count is given quantitatively.

I. Introduction

There have been two generally recognized health hazards in the manufacture of pottery, one due to the use of lead, the other to the breathing of air containing silica dust. The former is more easily dealt with since in most potteries the use of lead is localized to dipping and glaze making. It has been found that "fritting" the lead, *i.e.*, smelting it into a glass before grinding into the glaze mixture, removes the danger of lead poisoning if the lead silicates or borosilicates are compounded to be only slightly soluble in acids so that they are not readily absorbed by the system. The practice of "fritting" and other precautionary measures have been adopted by many potteries in which lead poisoning is almost unknown today. The dust problem, however, is more difficult; it is a problem not confined to the potteries and in fact is more serious in various other industries. The writer, therefore, was sufficiently concerned with it to undertake an experimental study of conditions in the plant to serve as a guide to remedial measures.

II. Dust Particle Count

In initiating this work, the writer was fortunate in having the assistance of Dr. Leonard Greenburg of the United States Public Health Service. Dr. Greenburg had been instrumental in the development of a convenient and efficient apparatus for dust determinations known as the impinger (Fig. 1).

(1) Impinger

In this machine, air is forced at high velocity through a nozzle under water, striking a brass plate, and is broken into many bubbles. Due to the inertia of the dust particles, the impinging serves to free them of the adhering air film so that they are wetted and retained by the water in the flask.

Note: A demonstration of the principle can be given with tobacco smoke in an ordinary pipette. If the smoke-laden air be blown slowly through water in a beaker or flask, the smoke can be seen to emerge. If, however, the end of the pipette be placed close to the bottom of the beaker and the smoke-laden air sharply ejected, the extremely fine tobacco smoke particles are absorbed and the air comes through clear.

The impinger machine is provided with a flow meter of the Venturi type which is calibrated against a gas meter. In operation air is sucked through at the rate of one cubic foot per minute and the time of sampling can be varied at will, 15 or 30 minutes being usual. The sample in the flask is diluted to 500 or 1000 cubic centimeters according to the time of sampling; 1 cubic centimeter portions are examined in a counting cell for the dust count at a magnification of 100×, objective and eyepiece each 10×. A factor is used to convert results to the number of particles per cubic centi-

* Presented at the Annual Meeting, American Ceramic Society, Pittsburgh, Pa., February, 1933 (Materials and Equipment Division). Received February 24, 1933.

meter of air. The remainder of the sample is filtered through a Gooch crucible to give the total weight of dust collected.

(2) Dust Count and Dust Weight To check the technique, two half-hour samples were taken under different atmospheric conditions. These were each divided in two and worked separately giving the results in Table I.

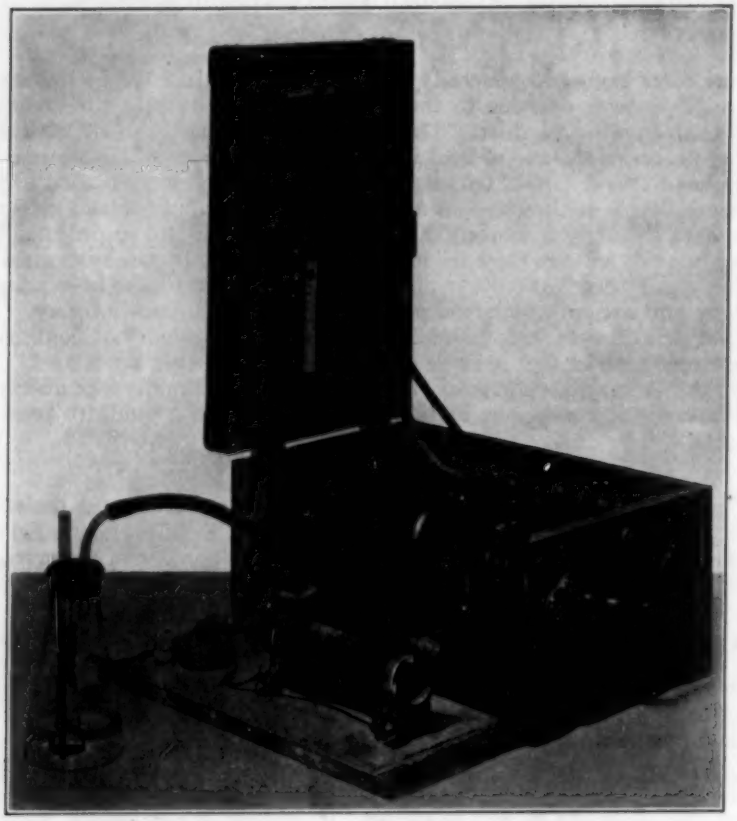


FIG. 1.

TABLE I
CHECK ON LABORATORY WORK

Sample	Dust count per cc. air		Dust weight (mg.)
	Total	Over 10μ	
1a	119	2.3	0.8
1b	125	2.1	0.6
2a	61	1.7	0.3
2b	51	1.1	0.3

As a further check simultaneous samples were taken with two machines, the results being recorded in Table II.

The number of large particles, over 10μ diameter, is not an important fraction of the total, nor are these larger particles important from a health standpoint, so that in later work this observation was omitted. The dust counts are fairly consistent throughout; the checks on the weighings appear less satisfactory but it must be remembered that very small quanti-

TABLE II

CHECK ON SAMPLING AND LABORATORY WORK

Sample	Machine	Dust count Total	Dust count >10μ	Dust weight (mg.)
1	A	244	3.4	3.2
1	B	274	3.5	2.1
2	A	224	4.1	1.4
2	B	228	3.4	1.9
3	A	48		1.4
3	B	54		0.8
4	A	56		0.8
4	B	58		0.8

ties are being considered. With low dust concentrations the counts appear more reliable than the weighings; with high concentrations the case is probably reversed since the counts become more difficult and the filtration and weighing subject to less error. It will be seen in what

FIG. 2.

follows that the counts and weighing are generally in agreement and the double method gives a rough check on the work.

III. Shop Studies

(1) Jigger Shop These determinations were begun in the jigger shop. The situation when the work was started may be briefly described as follows: In each unit there were three or four working crews, consisting of a jiggerman, a batter-out, and a finisher. The jigger-

man and batter-out making the ware handled only wet clay. The finisher, usually a girl, removed the dried ware from the molds, trimming, dusting, and arranging it in bungs. Evidently in this set-up, the finishing was the chief source of dust. The stove room for drying ware was at the workers' back and was provided with a series of slides with shelves (Fig. 2). Heat was supplied by a hot-air blast entering the back of the stove room, traveling forward, and escaping between the slides at the front, whence it was supposed to enter an overhead suction duct to be recirculated through the heating coils and stove room. During the summer

TABLE III

CLAY SHOP SURVEY

Shop condition	Description of sample	Dust count	Dust (mg.)
Windows closed, fan on	Shop, early morning (blank)	57	0.1
" " " "	Shop, crew working	132	1.95
" " " "	Stove room	103	0.5
" " " "	Hot-air supply duct	44	0.1
Windows closed, fan off,	Shop, early morning (blank)	43	0
and stairway screened	Shop, crew working	144	2.5
Windows open, fan on	Shop, crew working	97	0.5

months windows were kept open, making the atmospheric condition different from that of the winter period.

The first undertaking was a survey of the actual dust content of the jigger-shop air covering the range of operating conditions. A large number of tests was made (30-minute samples) with the surrounding details noted. The general averages are recorded in Table III.

The data in Table III serve to show the average amount of dust as compared to normally pure air and to indicate the effect of ventilating conditions. The detailed data brought out more clearly than the averages the effect of air currents. Thus in one day there was obtained an appreciable count in the morning with the outside air quiet and a negligible

TABLE IV

DUST TESTS IN CLOSED-OFF ROOM

Conditions of test	Dust count	Dust (mg.)
Early morning (blank)	40	
Ordinary working conditions	156	1.9
Exhaust hoods for finishers	99	1.0
Exhaust hoods and no air escape from driers	60	0.8

count in the afternoon with a sharp breeze blowing through the windows. A reversed effect was obtained by pulling out the stove-room slides, allowing the hot blast to sweep direct into the room. It will be noted in Table III that the hot-air supply duct gave low dust counts and that considerable dust was picked up by the air in traveling through the stove rooms.

Because of the impossibility of eliminating entirely stray air currents in the regular working units, one section of the shop was boarded off to serve as a testing laboratory for further studies in dust elimination. Tests were made daily over a period of a month or more under each of the following conditions: (*a*) ordinary working conditions; (*b*) with special

exhaust hoods for the finishing operation; (*c*) with special exhaust hoods and with stove-room circulation arranged to prevent escape of hot air into the working room. The general averages are recorded in Table IV.

(2) Separate Finishing Room These experiments clearly indicated the line of attack for eliminating dust from the jigger-shop air. Since the finishing was a main source of trouble, it was decided to reorganize the whole jigger-shop procedure by centralizing that operation in two rooms. This change made it possible and economical to provide adequate suction hoods for the finishers. Details of the finishing hood are shown in Fig. 3 and a battery of hoods in Fig. 4. The following tests made close to the finisher show the efficiency of the system.

FIG. 3.

TABLE V

DUST TESTS NEAR FINISHER

Conditions of test	Dust count	Dust (mg.)
Old finishing; no suction	228	5.9
New finishing bench; suction	129	1.2

(3) Stove Rooms The dust survey proved the necessity of stopping the air leakage from the stove rooms. Placing the whole drying system under suction was not feasible and accordingly a closed-circuit pressure system was next established. The escape of air was observed by taking anemometer readings at the top and bottom of slides at two points, A and B, at the front of the stove room. The original drier (Fig. 5) with air blast at the back and overhead external suction duct gave anemometer readings as follows:

FIG. 4.

A top	A bottom	B top	B bottom
774	715	831	884

The first modification consisted in closing the main suction duct to the room air while connecting it to the drier by a series of narrow vertical flues placed between the slides. With this arrangement it was possible to reverse the air flow, supplying the blast through the vertical flues and taking the discharge from the back. Anemometer readings corresponding to the above under this system were as follows:

A top	A bottom	B top	B bottom
330	151	198	278 (draft in)

The altered system had two serious defects (*a*) the vertical supply flues constituted an excellent radiator and caused overheating of the shop and (*b*) drying of the ware in different parts of the slide was very unequal. With the same construction, it was decided to return to the air supply through distributing screens at the back, obtaining the following readings:

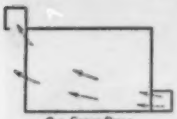


Fig. 5

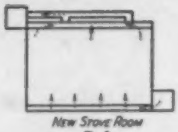


Fig. 6

A top	A bottom	B top	B bottom
362	181	264	116

This method gave more even drying but there was still excessive heating from the vertical flues.

Further consideration of the problem led to the conclusion that better control over air leakage and at the same time improved drying would be obtained by substituting a rising vertical column for the horizontal air movement. There was very little space available between the slides, but it appeared possible to install a system of narrow horizontal supply ducts in place of the guard rail between the slides at the bottom. The system finally adopted is shown diagrammatically in Fig. 6. The main pressure duct at the back of the stove room supplies air to the system of horizontal ducts whence it rises to a new suction chamber extending across the entire top of the stove room. By providing properly spaced take-offs from this suction chamber an even distribution of air is obtained giving improved drying as well as economies in power and steam. This system has been installed throughout the plant. Typical anemometer readings are as follows:

A top	A bottom	B top	B bottom
215	0	218	0

Fig. 7.

(4) Kiln Placing Rooms The discussion so far has been confined to the jigger shop. In the manufacture of vitreous china tableware there are other sources of dust in the "bedding" or placing operation and in cleaning the ware after the first or biscuit fire. These problems are less acute in most semi-vitreous and in true porcelain plants where a supporting bed is not employed. Flint is the cheapest and most commonly used bedding material, and, unfortunately, silica is the most harmful of the common mineral dusts. This situation has been a source of much concern in England where flint is largely used for bedding bone china.

An interesting discussion is found in a paper by Moore.[1] Two methods of mitigation referred to are (*a*) elimination of the fines from the placing flint, thereby removing the harmful portion, and (*b*) substitution of other

[1] *Trans. Ceram. Soc.* [Eng.], **31**, 153 (1932).

materials, especially bone ash and alumina. For a great many years this company has used kaolin instead of quartz for placing. The operation of claying up the bungs of ware is carried out under a hood with strong draft (Fig. 7). Similar precautions are taken in cleaning the ware after the fire (Fig. 8).

IV. Medical Aspect

It is not within the scope of the present report to consider in detail the medical aspects of the subject. Much valuable work has been done by

FIG. 8.

the United States Public Health Service, some of which will be briefly reviewed.

Any mineral dust entering the lungs causes the formation of a fibroid tissue reducing the area of effective lung tissue, a condition known as fibrosis. The development is gradual and a long period of years may elapse before marked physiological effects, notably a shortness of breath, become apparent. There is a lowered resistance to respiratory diseases, colds, bronchitis, pneumonia, and tuberculosis. It has been clearly established that silica dust is especially harmful, and the resulting condition is known as silicosis.

It was thought at first that the bad effect of silica was due to the hard

character of the mineral. This view, however, is inconsistent with the observation that a still harder dust, silicon carbide, does not produce the same physiological effects, and especially the same susceptibility to tuberculous infection. The specific effect of silica is thought to be associated with its solution and the formation of colloidal silicic acid, which apparently tends to destroy the phagocytes or natural scavenging cells, which normally attack and absorb poison, or tubercle bacilli.

Studies in South Africa and in this country indicate that practically no particles over 10μ diameter enter the lungs, and very few over 5μ, so that the dangerous dust is the finer, microscopic fraction. Particles below 0.1μ are of the order of size of the body colloids and probably harmless in the case of inert minerals. If, however, the chemical theory of the toxicity of silica is accepted, there can be no lower limit to the particle size which will be harmful.

One of the most complete correlations between dust exposure and medical histories is contained in a study of the granite industry by the U. S. Public Health Service.[2] This is particularly interesting since granite dust contains 35% free quartz, about the average content of pottery bodies. Some of the more important conclusions will be quoted from *Health News*, a release of the Public Health Service.

> It was possible, by differentiating occupations on the basis of the amount of dust exposure, to determine within broad limits how much dust of the composition studied can be tolerated by workers without serious deleterious effects. A maximum of dust exposure falling somewhere between 10 and 20 million particles per cubic foot of air is a desirable limit (for dust containing 35% free silica).
>
> Exhaust velocities at the ventilating hoods of 1500 feet per minute served to keep the dust exposure of the operator below 10 million particles per cubic foot of air. The limit established was not found to prevent entirely the occurrence of silicosis, but there seemed to be no particular liability to tuberculosis within this limit.
>
> Case histories of men working in the granite industry brought out the following salient points:
>
> (*a*) The long period of service (20 years or more) before the liability to tuberculosis becomes manifest.
>
> (*b*) The sharp correlation between length of exposure to dust and the prevalence of tuberculosis and also the death rate from this disease.
>
> (*c*) The close relation between the extent of dust exposure and the health of the men.

V. Maximum Dust in Potteries below Dangerous Minimum in Granite Quarries

Conditions in the potteries have never approached, to the knowledge of the writer, those prevailing in granite quarrying as set forth in the foregoing. It is to be noted that a dust count of 10 to 20 million particles per cubic foot is described as a desirable condition. This corresponds to 352 to 704 particles per cubic centimeter. Before the work described in this report was begun, the average dust count in the clay shop was about 150 or less than half the strictest requirement of the Public Health Service. Through the measures described this low figure has again been cut in two. The count of about 130 near the hoods in the finishing rooms is misleading, for nearly all of this consists of kaolin sprinkled on the ware and the equivalent count in terms of 35% free quartz is too low for measurement.

It therefore appears that conditions have been improved to a point

---

[2] *Public Health Bull.*, No. 187 (1929).

where the dust hazard formerly associated with the manufacture of pottery no longer exists.

Bibliography

(1) Final Report, Miners' Phthisis* Prevention Committee, Union of South Africa, Govt. Printing and Stationery Office, Pretoria, 1919.

(2) A. Mavrogordato, "Studies in Experimental Silicosis and Other Pneumoconioses," S. African Inst. for Medical Research, *Publication*, XV, Johannesburg, March 31, 1922.

(3) R. R. Sayers, "Silicosis among Miners," U. S. Dept. of Commerce, Bur. Mines, 1925.

(4) "Health of Workers in Dusty Trades, II: Exposure to Siliceous Dust (Granite Industry)," U. S. Public Health *Bull.*, No. 187.

(5) "Silicosis among Rock Drillers, Blasters, and Excavators in New York City, Based on the Study of 208 Examinations," *Jour. Industrial Hygiene*, 9 [2], 37–81 [Feb.] (1929).

* The word "phthisis" is here used to mean "silicosis" complicated by tuberculosis

SELENIUM RUBY GLASS: PREPARATION AND X-RAY STUDY*

By Maurice H. Bigelow with Alexander Silverman

ABSTRACT

A study has been made of color produced by selenium and accessory substances in sodium oxide–zinc oxide–silica glasses. Most desirable reds were obtained by adding selenium, cadmium sulfide, arsenic trioxide, and carbon to a foundation batch. X-ray examination indicates that the red color produced is probably due to a solid solution of CdS in CdSe.

I. Purpose of the Investigation

Many theories and some conflicting statements have appeared in the literature dealing with selenium glasses. It is the aim of this investigation to determine conditions which govern the formation of selenium colors in a simple series of sodium oxide–zinc oxide–silica glasses.

With an attempt to keep conditions constant and to check carefully the composition of raw materials, this investigation aims to determine the nature of the coloring agent and avoids the introduction of anything which renders the problem complex.

II. Historical Data

Ruby glasses have been made for several centuries. The first red glass was copper ruby. This lacked the brilliance of its successors. Gold was not used prior to the XVI Century. An excellent gold ruby was made near Potsdam by Kunckel.

In 1865 a patent covering the use of selenium for coloring glasses red was obtained by the French chemist, J. T. Pelouze. A German patent was issued in 1892 to Welz[1] for the use of selenium or selenium compounds for producing rose, red, and orange glass.

In 1893 H. T. and W. R. von Kralik obtained a British patent for the use of selenium and its compounds in glassmaking. The next year a German patent was granted Spitzer[2] for the use of selenites and selenates. Since then selenium and its compounds have found increasing use.

Zsigmondy[3] demonstrated that in gold ruby glass, colloidal gold is responsible for the color, and that by varying the size of the particles through heat treatment, colors range from colorless through red to blue. As gold glasses were light amber when taken from the pot and the ruby color developed on reheating after cooling the gather, and as selenium glasses behaved similarly, the question naturally arose among investigators of the latter as to how selenium formed a ruby color. Many attempts were made to answer the question. They were at variance and frequently speculative. Batch composition and acid and basic conditions were considered.

---

* Submitted to the Graduate School, University of Pittsburgh, by Maurice H. Bigelow, in partial fulfillment of requirements for the Ph.D. degree.

Contribution No. 262 from the Department of Chemistry, University of Pittsburgh.

Presented at the Annual Meeting, American Ceramic Society, Pittsburgh, Pa., February, 1933 (Glass Division). Received January 31, 1933.

[1] F. Welz, *Ber.*, **25**, 819 (1892).

[2] A. Spitzer, *ibid.*, **27**, 777 (1894).

[3] R. Zsigmondy, The Chemistry of Colloids, p. 12, New York (1917).

Treadwell,[4] Fenaroli,[5] Kraze,[6] Witt,[7] Frankel,[8] Krak,[9] Granger,[10] Fuwa,[11] and Sugie[12] were among these investigators.

Silverman[13] has suggested that in glasses containing arsenic, arsenosulfoselenides may account for the color since such compounds are red in thin sections.

Rooksby[14] has shown that in samples of commercial selenium ruby glasses X-ray diffraction patterns show the presence of a solid solution of cadmium selenide and cadmium sulfide. The color ranges from orange to ruby depending on the concentration of cadmium selenide, the ruby color being most intense as one approaches 100% cadmium selenide in the coloring agent. The intensity seems to be due to color of the particles in the glass and is not wholly dependent upon their size. Using magnifications of 5000× Rooksby was unable to observe a change in color with change in particle size.

III. Experimental Procedure

(1) Containers Crucibles capable of standing a large temperature range, resisting corrosion, and of high purity were made from North Carolina kaolin 450 grams, Florida kaolin 150 grams, Tennessee ball clay 150 grams, and cyanite 250 grams.

These materials were ground in 1500 cubic centimeters of water and then enough 10% sodium silicate solution was added to form a slip. Crucibles were cast in plaster molds, dried, and fired at 1300°C. The capacity was one kilogram of batch.

(2) Raw Materials Sand, 140-mesh white Mapleton jasper, analyzing SiO_2 99.81%, Al_2O_3 0.17%, Fe_2O_3 0.014%; sodium carbonate, anhydrous, C.P, containing 99.96% Na_2CO_3 and less than 0.01% Fe_2O_3; zinc oxide, U.S.P., manganese free, containing 99.94% ZnO.

Cadmium sulfide, arsenic trioxide, antimony trioxide, selenium, sugar carbon, sulfur, zinc, and aluminum were chemically pure materials.

Cadmium selenide was prepared by passing a mixture of pure hydrogen and hydrogen selenide over solid anhydrous cadmium chloride heated to 450°C. The residue from the tube was repeatedly washed with water and carbon disulfide, respectively. The final product was pure cadmium selenide as shown by chemical and X-ray analysis.

Solid solutions of cadmium selenide and cadmium sulfide were prepared by directly fusing equimolar portions of the two substances together in closed containers at 1300°C. Photograms of this synthesized solid solution closely agreed with those made of the ruby glass. (See Tables I and II.)

---

[4] W. D. Treadwell, *Keram. Rundshau*, **20**, 220 (1912).
[5] P. Fenaroli, *Chem.-Ztg.*, **36**, 1149 (1912); *Sprechsaal*, **45**, 659 (1914); *ibid.*, **47**, 183, 203 (1914); *Hollander Zeit.*, **16**, 53 (1915).
[6] F. Kraze, *Sprechsaal*, **44**, 707 (1911); *ibid.*, **45**, 215 (1912); *Ind. Eng. Chem.*, 539 (1912); *Sprechsaal*, **44**, 142 (1911).
[7] O. N. Witt, *Sprechsaal*, **47**, 444 (1914).
[8] E. Frankel, Diss. Wurzburg (1920).
[9] J. B. Krak, *Jour. Amer. Ceram. Soc.*, **12** [8], 530 (1929).
[10] H. A. Granger, *Trans. Ceram. Soc.* [Eng.], **21**, 89 (1922).
[11] K. Fuwa, *Jour. Jap. Ceram. Soc.*, **32**, 327 (1924).
[12] S. Sugie, *ibid.*, **29**, 341 (1921).
[13] A. Silverman, *Trans. Electrochem. Soc.*, **61**, 101 (1932).
[14] H. Rooksby, *Jour. Soc. Glass Tech.*, **16**, 171 (1932).

(3) Foundation Glass A series of sodium oxide–zinc oxide–silica glasses was made in an attempt to find a batch which would melt to a clear glass and remain clear throughout the natural cooling period of the furnace.

The furnace used was a gas-fired surface combustion type, having a hearth area of 4 square feet and lined with "alusite" high-temperature brick. Throughout every given melt the temperature was periodically checked with an optical pyrometer and Seger cones.

The batches were introduced into the cold furnace. The temperature was raised to 1300°C and held there for three hours, then lowered to 1000°C in two hours. The furnace was then allowed to cool naturally to room temperature. The entire time involved for a complete melt averaged 30 hours.

In loading the furnace, care was always taken to have the same volume of material to be fired so that the total heat capacity of the furnace lining and contents remained the same.

A constant gas and air ratio was maintained throughout the tests. The nature of the furnace atmosphere was determined by analyzing the flue gas. A slightly oxidizing atmosphere was maintained. Covered crucibles were used.

To avoid contamination from screens, batches were mixed directly on a large oil cloth. Batches of the basic glass were prepared as required to prevent any change of the basic ratio through settling or moisture absorption.

To determine a suitable foundation glass, batches yielding the following compositions were fired:

(1) $Na_2O:ZnO:8SiO_2$
(2) $Na_2O:ZnO:7SiO_2$
(3) $Na_2O:ZnO:6SiO_2$
(4) $Na_2O:ZnO:5SiO_2$
(5) $Na_2O:ZnO:4SiO_2$
(6) $Na_2O:2ZnO:4SiO_2$
(7) $2Na_2O:ZnO:4SiO_2$

Glass No. 1 was entirely devitrified; Nos. 2, 3, and 4 showed less and less devitrification; 5, 6, and 7 were entirely clear and free from color; 5 was chosen as the foundation glass, because of its higher silica content.

(4) Color Trials More than two hundred trial melts were made by adding various chemicals to a batch yielding the foundation glass mentioned above. These additions included carbon, aluminum, zinc, sulfur, selenium, cadmium sulfide, arsenic trioxide, and antimony trioxide, as individual substances and as two-, three-, and four-component mixtures. A blank was included in each series to see if it produced a colorless glass, thus insuring correct color interpretation in other members of a given series. Where selenium was a component its concentration was 0.125, 0.25, 0.5, 1.0, 1.5, and 2.0% of the basic batch weight, respectively. When carbon additions were made they constituted 0.5% of the basic batch weight. For arsenic trioxide additions, 1.0% was used, and antimony trioxide substituted as a molecular equivalent. All other substances were added as 1.0% of basic batch weight. The various glasses ranged from colorless through yellow, amber, orange, and red to a very dark red-brown. The best ruby glass resulted from adding 2.0% selenium, 1.0% cadmium sulfide, 1.0% arsenic trioxide, and 0.5% carbon to the basic batch. After annealing at 350 to 400°C for 30 hours

to increase the size of crystallites, and then pulverizing, the ruby glass was subjected to X-ray examination by the powder method.

(5) X-Ray Studies Glass, though ordinarily considered a supercooled solution, gives rise to broad X-ray diffraction patterns.[15] Glasses containing precipitated crystalline components, which show microscopically, should yield sharp diffraction lines. It has been reported[16] that selenium and copper-ruby glasses fail to produce sharp lines.

X-ray photograms were prepared by the Debye-Scherrer[17]-Hull[18] method. The X-rays were obtained from a Phillips type tube equipped with a copper target and an aluminum window 0.001 inch thick. The Kβ lines of the copper radiation were reduced in intensity by a nickel oxide filter. The specimens were mounted on an iron spindle on the axis of a cylindrical camera with an effective diameter of 57.3 millimeters. The specimens were rotated during the exposures, which required about 1500 milliampere minutes at approximately 35 kilovolts peak.

TABLE I

hkl	Obs. Int. Zach.[a]	CdSe		α CdS		θ Solid solution of α CdS and CdSe	θ Ruby glass
		θ Zach.[a]	θ Obs.[a]	θ Calc.	θ Obs.		
100	4	11.92	11.95	12.38	12.5	12.25	12.25
002	1.5	12.77	12.80	13.23	13.3	13.0	13.25
101	3	13.52	13.62	14.08	14.2	14.0	13.8
102	1	17.46	17.70	18.28	18.3	18.1	17.5
110	5	20.95	21.0	21.43	21.8	21.5	21.5
103	3.5	22.85	23.1	23.88	23.8	23.3	23.6
200	1	24.37	*	25.41	*	*	*
112	4	24.79	24.9	25.88	25.3	25.4	25.5
201	1	25.24	*	26.38	26.4	*	*
202	5	27.94	27.9	29.13	29.1	28.5	28.9
203	3.5	31.93	32.0	33.36	33.2	32.9	32.9
210	1	33.18	33.3	34.62	34.7	34.0	33.9
211	1.5	33.92	34.2	35.42	35.5	34.9	34.9
105 / 212	2.5	35.97	36.2	37.74	37.7	37.6	37.2
300	2	38.36	38.5	40.10	40.0	39.7	39.5
213	3.5	39.71	39.9	41.58	41.5	41.0	41.0
302	2	41.16	41.3	43.13	43.3	42.4	42.4
205	2	43.45	43.6	45.67	45.6	44.8	44.6
220	2	45.75	45.9	48.05	48.4	47.2	47.6
222 / 116	4	48.54	48.9	51.21	51.4	50.2	50.2
215	4	50.79	49.9	53.73	54.0	52.7	52.7
313	4	54.53	54.7	57.85	58.0	56.4	56.5

[a] See footnote 19, p. 218.
* These very weak lines are not well resolved, and no attempt was made to measure them.

The α CdS used in preparing the X-ray photograms was made by heating β CdS to 1300°C for one hour. The β form of CdS has a cubic lattice which transforms to the α form with a hexagonal lattice on heating.

[15] J. T. Randall, H. P. Rooksby, and B. S. Cooper, "The Structure of Glasses," *Jour. Soc. Glass Tech.*, **14**, 219 (1930).
[16] C. W. Parmelee, G. L. Clark, and A. E. Badger, *ibid.*, **13**, 285 (1929).
[17] P. Debye and P. Scherrer, *Physik. Z.*, **17**, 277 (1916).
[18] A. W. Hull, *Phys. Rev.*, **10**, 661 (1917).

The measured and computed diffraction angles θ of the Cu-Kα lines from the planes with Miller indices *hkl* are shown in Table I, columns 2 to 6, inclusive.

The diffraction angles θ observed for CdSe by W. Zachariasen[19] are listed in column 3, Table I, for comparison. Although the diffraction angles θ have been observed for CdS[20] they were not readily available to the authors. The angles θ for α CdS were computed, using the relation[21]

$$\sin^2\theta = \frac{\lambda^2}{3a_0^2}(h^2 + hk + k^2) + \frac{\lambda^2 l^2}{4c_0^2}$$

The mean wave-length for the Cu-Kα lines used in these calculations was 1.539 Å. The lattice constants, $a_0 = 4.14$ Å and $c_0 = 6.72$ Å, were obtained from Wyckoff.[22] The Miller indices used were assumed by comparison with those given by Zachariasen for CdSe,[19] since the space lattice of the two compounds is similar.

The results of the X-ray measurements on the solid solution and on the coloring agent in the glass are given in Table II.

TABLE II

LATTICE CONSTANTS OF SYNTHESIZED SOLID SOLUTION OF CdS AND CdSe, AND OF COLORING AGENT IN GLASS

	a_0	c_0	c_0/a_0
Solid solution	4.19 Å	6.85 Å	1.63
Coloring agent	4.19 Å	6.78 Å	1.62

The agreement between the values of the lattice parameters a_0 and c_0 and their ratio c_0/a_0 for the solid solution and for the coloring agent in the glass makes it appear quite probable that the coloring agent in the glass is a solid solution of cadmium sulfide and cadmium selenide. It is possible, however, that the synthesized solid solution may contain excess cadmium, and that the coloring agent in the glass may contain traces of other materials from the glass, in addition to excess cadmium.

As colorless selenium glass undergoes a coloration when exposed to X-rays, no photograms of colorless glass were made.

IV. Summary

(1) A foundation glass has been prepared which remains clear over a wide range of conditions. This has the formula $Na_2O:ZnO:4SiO_2$.

(2) To the batch producing this glass various additions of carbon, zinc, aluminum, sulfur, selenium, arsenic trioxide, and cadmium sulfide have been made. This study included over two hundred trials.

(3) The batch yielding the best ruby glass contained 2.0% selenium, 1.0% cadmium sulfide, 1.0% arsenic trioxide, and 0.5% carbon.

(4) Cadmium sulfide proved essential to the production of the ruby color.

(5) A solid solution of cadmium sulfide and cadmium selenide was prepared.

---

[19] W. Zachariasen, *Z. physik. Chem.*, **124**, 436 (1926).
[20] F. Ulrich and W. Zachariasen, *Z. Krist.*, **62**, 260 (1925).
[21] H. Ott, Handbuch Exp. Phys., Vol. 7, p. 220, Leipsig, Germany (1928).
[22] R. W. G. Wyckoff, The Structure of Crystals, p. 225, New York (1931).

(6) Diffraction angles θ were computed for α cadmium sulfide and for cadmium selenide. X-ray studies of these substances were in agreement with the calculations.

(7) X-ray studies of the solid solution of cadmium sulfide and cadmium selenide and of the ruby glass mentioned in paragraph 3 of this summary were made and the lines recorded were in close agreement.

V. Conclusion

The red color in the selenium ruby glass mentioned in paragraph 3 of the summary is probably due to a solid solution of cadmium sulfide and cadmium selenide, with the further possibility that traces of other materials from the glass may be present in the solid solution.

Acknowledgment The authors express their appreciation to V. Hicks and to M. Gensamer for their coöperation in the X-ray studies and in the checking of data; also to A. Ruark for his guidance and criticism.

STRESSES IN DOMES AND CROWNS OF CIRCULAR KILNS*

By J. N. Goodier

ABSTRACT

Previous papers on the analysis of stress in various kinds of domes and crowns of circular kilns point to the desirability of a simple and general method applicable to any proposed shape, and capable of indicating what shape will ensure the satisfaction of certain special stress conditions. The method given here can be applied graphically or analytically to domes or kilns, either complete or with circular openings in the crown.

The principal point of interest for masonry structures is whether tensile stresses will occur or not, their occurrence being regarded as a criterion of instability. In domes the circumferential stress (acting across vertical sections through the axis of symmetry) may or may not be tensile according to the shape of the profile. It is shown that domes whose profiles are parabolas or catenaries are free from tensile stress, whether open at the top or not, and that openings are favorable to stability in kiln crowns of any shape of profile. The particular shape which ensures complete freedom from circumferential stress, tensile or compressive, is investigated with results at variance with those of a recent paper.[1]

The principal conclusions arrived at are given in the summary.

I. Introduction

Figure 1 represents the middle surface (the surface midway between the internal and external wall surfaces) of a dome symmetrical about the vertical axis. The light curved lines indicate the strip between two vertical sections made by planes through the vertical axis. The small shaded area is cut from this by two horizontal sections. Figure 2 represents this small element separated from the dome. The edges of the actual element of the wall are indicated by the broken lines. It should be noticed that the short edges are not horizontal, but normal to the middle surface, that is, since the wall is taken as very thin, normal to either of the wall surfaces.

The stresses p and q shown in the figure stand for the average stresses across the thickness. They are the same at all points at the same level on account of the symmetry. It may be that the stress is not constant throughout the thickness of the wall. If it is not, the excess or defect from the average contributes a bending moment, as in a beam. There would then be bending moments acting on each edge of the wall element. There might also be shearing forces on the pair of edges on which p and $p + \delta p$ act, but not on the other pair by reason of the symmetry.

Engineers have usually been content to ignore these bending moments and shearing force, and this precedent will be followed here, although it must be recognized that no satisfactory justification for it has yet been given on account of the mathematical complexity of the unsimplified problem. It would be correct for a masonry dome if the mortar were to

---

* Presented at the Annual Meeting, American Ceramic Society, Pittsburgh, Pa. February, 1933 (Refractories Division).

Author's Note: Since writing the paper, the author has been informed, through the kindness of Professor S. Timoshenko, of a brief article on the subject in the Handbuch der Physik, Vol. VI (J. W. Geckeler, "Elastostatik," Art. 63, p. 236). The character of the circumferential stress for typical circular, linear, elliptical, and parabolic generating curves, is indicated graphically. The cubical parabola is also represented, and the property of constant (with the possibility of zero) circumferential stress attributed to it. This, of course, disagrees with the result found above for the shape of the dome of no circumferential stress, and calculations by the writer for the cubical parabola do not confirm the statement in the Handbuch.

[1] J. A. Fellows, "Domes for Circular Kilns," *Jour. Amer. Ceram. Soc.*, **15** [9], 508–16 (1932).

resist direct thrust but permit minute rotations. It would also be valid for walls extremely thin in comparison with the overall dimensions. The breaking stress of a strip of paper can be reached easily by pulling it in the hands, but not by the sharpest bending attainable in a crease.

It is assumed then that only the direct stresses are of importance when the walls are thin. This problem is thus very much simplified, becoming one of pure statics instead of elasticity. The specific gravity of the material is the only physical constant involved.

The geometrical features of the dome are implied by the shape of the profile or generating curve (Fig. 1). On this curve, which may be regarded as any vertical section of the dome, any point is associated with the following quantities (Fig. 1):

r = distance from axis
z = depth below vertex
s = length of arc of the curve from vertex to point
ϕ = angle between tangent to curve at the point and the horizontal

II. Stress Formulas

There are two equations of equilibrium for the element of Fig. 2, and these suffice to determine the two unknowns, p and q. The equations can

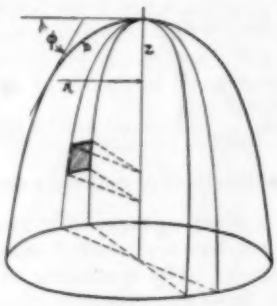


FIG. 1.

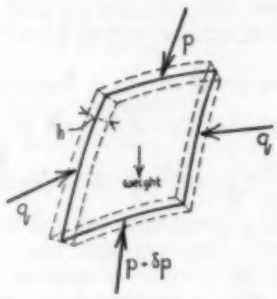


FIG. 2.

be written in various ways, from which a choice is made to suit future convenience. Resolving horizontally and vertically it is found that

$$\frac{d}{ds}(pr \sin \phi) = \rho r \tag{1}$$

$$q = \frac{d}{ds}(pr \cos \phi) \tag{2}$$

where ρ = specific gravity.

Integrating the first, $pr \sin \phi = \rho \int_0^r r ds$

This merely expresses the fact that the stress p in the wall at any given height supports the weight above this height. This is readily seen by multiplying through by $2\pi h$, where h is the wall thickness, and observing that $2\pi \int_0^r r ds$ is the area of the surface from the vertex to the section of

radius r. It follows that if the dome is open at the top, the radius of the opening being b, the lower limit of the integral must be b instead of zero. The formula for the stress, p, may therefore be written

$$p = \frac{\rho}{r \sin \phi} \int_b^r r ds \tag{3}$$

b being zero if there is no opening.

When p is found (2) constitutes a formula for q, or alternatively we may substitute for p and write

$$q = \rho \frac{d}{ds}\left[\cot \phi \int_b^r r ds \right] \tag{4}$$

Put $2\pi \int_0^r r ds = A$, $2\pi \int_0^b r ds = A_0$, so that A is the area down to the radius r, and A_0 the area down to the radius b. Then $\int_b^r r ds = \int_0^r r ds - \int_0^b r ds = \frac{A}{2\pi} - \frac{A_0}{2\pi}$, and

$$q = \frac{\rho}{2\pi} \frac{d}{ds}\left[A \cot \phi - A_0 \cot \phi \right]$$

$$= \frac{\rho}{2\pi}\left[\frac{d}{ds}(A \cot \phi) - \frac{d}{ds}(A_0 \cot \phi) \right]$$

Since $\cot \phi$ will decrease continuously as s increases, in domes of the usual forms (convex upward), and A_0 is a constant, $\frac{d}{ds}(A_0 \cot \phi)$ will be negative, and $-\frac{d}{ds}(A_0 \cot \phi)$ will be positive. Thus the effect of making an opening is to add a compressive stress to q, so that it is advantageous in respect of stability. This, perhaps, may explain why it has been found safe to cut holes out of circular crowns for repair purposes. The mounting of an additional weight on an opening will of course have the opposite effect.

The stresses are proportional to the specific gravity, so that if the brick are liable to mechanical failure, the most favorable condition from the present standpoint is attained by securing the highest possible ratio of crushing strength to specific gravity.

The expressions (3) and (4) for p and q can be evaluated graphically for any given curve. For any given point on the curve, the radius r and the angle ϕ can be measured. The integral $\int_b^r r ds$ can be estimated by dividing up the curve into small lengths, ds, multiplying by the corresponding radii, r, to the middle of the small lengths, and adding the results as far as the point in question. The process is equivalent to the graphical determination of the center of gravity of the arc of the curve. It is seen from (4) that q will be positive, *i.e.*, compressive, wherever $\cot \phi \int_b^r r ds$ is increasing along the curve from the vertex, and tensile wherever it is decreasing. If the values of $\cot \phi \int_b^r r ds$ are plotted against those of s, the

values of q are obtained by multiplying the slopes of the resulting curve by the specific gravity.

When the profile curve is represented by a simple equation which leads to a simple formula for the integral $\int rds$, the expressions (3) and (4) can be evaluated analytically instead of graphically. This is done below, first for spherical and conical shapes, to confirm the correctness of the formulas (3) and (4), and then for the shapes generated by revolution of parabolas and catenaries. It is not necessary to specify the actual proportions of the dome, since the portion of any dome below a given level can

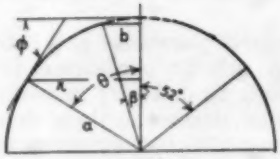


FIG. 3.

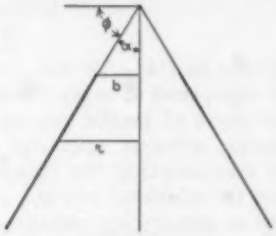


FIG. 4.

be replaced by a foundation or skewback without affecting the stresses in the upper portion. The reactions on the foundation or skewback are then represented by the stress at that level.

III. Applications to Particular Shapes

For domes which are caps of spheres, Fig. 3 shows that

$$r = a \sin \theta, \phi = \theta, ds = ad\theta$$

so that

$$\int_b^r rds = \int_\beta^\theta a^2 \sin \theta \, d\theta = a^2 (\cos \beta - \cos \theta)$$

$$\text{and from (3) } p = \rho a \cdot \frac{\cos \beta - \cos \theta}{\sin^2 \theta}$$

and from (4)

$$q = \rho a \cdot \left[\cos \theta - \frac{\cos \beta - \cos \theta}{\sin^2 \theta} \right]$$

If there is no opening $\beta = 0$ and

$$p = \rho a \cdot \frac{1}{1 + \cos \theta}, \quad q = \rho a \cdot \frac{\cos^2 \theta + \cos \theta - 1}{1 + \cos \theta}$$

These agree with existing formulas for spherical domes.[2] The circumferential stress q, when there is no opening, is compressive from the top as far as $\theta = 52°$ (Fig. 3), and then it becomes tensile. At the base of a hemispherical dome, for instance, it is a tensile stress of magnitude ρa. But if there is an opening at the top it is $\rho a \cos \beta$. The opening reduces the tensile stress but can not eliminate it altogether. The stress p, in the com-

[2] A. and L. Föppl, *Drang u. Zwang*, Vol. 2, p. 12.

plete dome, has its least value, $\frac{1}{2}\rho a$, at the top, and its greatest value, ρa, at the base of the hemisphere.

For a cone (Fig. 4), $\phi = 90° - \alpha$

$$ds = \frac{dr}{\sin \alpha}, \quad \int_b^r r\,ds = \frac{r^2 - b^2}{2 \sin \alpha}$$

and

$$p = \rho \cdot \frac{r^2 - b^2}{r \sin 2\alpha}$$

$$q = \rho r \tan \alpha$$

The opening in this case has no influence on the circumferential stress, q, which is compressive everywhere.

In the cases of profile curves in the forms of parabolas and catenaries only domes without openings at the top will be considered in order to avoid complicating the formulas. There is no difficulty in making the necessary calculations but the circumferential stresses in these domes are shown to be always compressive, so that the additional compressive stress set up by cutting out openings is not of much importance.

For the parabola $r^2 = 4cz$ (Fig. 1) the arc is given by

$$s = c(u + \tfrac{1}{2} \sinh 2u)$$

where $2c \sinh u = r$. As the result of a simple integration it is found that

$$\int_0^r r\,ds = \tfrac{4}{3}c^2 (\cosh^3 u - 1)$$

Also

$$\cos \phi = \frac{dr}{ds} = \operatorname{sech} u, \quad \sin \phi = \tanh u$$

and the final stress-formulas appear as

$$p = \tfrac{2}{3}\rho c \cdot \frac{\cosh^4 u - \cosh u}{\sinh^2 u} = \tfrac{2}{3}\rho c \cdot \frac{c}{z}\left[\left(1 + \frac{z}{c}\right)^2 - \sqrt{1 + \frac{z}{c}}\right]$$

$$q = \tfrac{2}{3}\rho c \cdot \frac{2 \cosh^3 u - 3 \cosh u + 1}{\cosh u \sinh^2 u} = \tfrac{2}{3}\rho c \cdot \frac{2\left(1 + \frac{z}{c}\right)^{3/2} - 3\sqrt{1 + \frac{z}{c}} + 1}{\frac{z}{c}\sqrt{1 + \frac{z}{c}}}$$

It is easily proved that the circumferential stress q is always positive, and it is therefore compressive throughout any parabolic dome. The value of c is obtained from the equation of the parabola by substituting the base radius, a, for r, and the height h, or z, whence $c = a^2/4h$. The expression for p assumes an indeterminate form at the top, but can be evaluated by the usual processes for evaluating the quotient of two vanishing quantities. The result is ρc or $\frac{\rho a^2}{4h}$. If $h = a$, so that the dome has the same base and height as the hemispherical dome, this stress is $\frac{1}{4}\rho a$, which is one-half the corresponding stress in the hemisphere. This is a consequence of the greater curvature of the vertex of the parabola.

The equation of a catenary with vertex at the origin is

$$z = m\left(\cosh\frac{r}{m} - 1\right)$$

where m also is determined by the base and height of the dome.[3] For this curve, writing v for r/m, it is found that

$$s = m \sinh v,\ \cos\phi = \frac{dr}{ds} = \operatorname{sech} v,\ \sin\phi = \tanh v$$

$$\int_0^r r\,ds = m^2 (v \sinh v - \cosh v + 1)$$

and with these the stress formulas become

$$p = \rho m \cdot \left[\cosh v + \frac{1 - \cosh v}{v \tanh v}\right]$$

$$q = \rho m \cdot \frac{1}{1 + \cosh v} = \frac{\rho m^2}{2m + z}$$

Again the circumferential stress q is everywhere compressive. That this is the case for parabolas and catenaries possibly accounts for the fact, recorded by F. H. Norton, that "a few kiln crowns have been built with a catenary or parabolic section, apparently with considerable success." The expression for p requires special consideration at the vertex, and it appears that its value there is $\frac{1}{2}\rho m$. When the base radius is equal to the height this is about $0.3\rho a$, which is less than for the hemisphere but greater than for the parabolic dome.

The ellipsoid of revolution can also be treated analytically without difficulty, although the expressions are cumbersome. The circumferential stress is not always compressive, but changes to a tensile stress at a level depending on the eccentricity of the generating ellipse.

These results may be summarized by saying that if tensile stress is to be avoided the hemisphere is probably the worst possible shape for a dome or kiln crown, and it is much better to use a shape intermediate between the hemisphere and the included cone, as nearly conical as possible near the base.

IV. Special Stress Conditions

If some special condition is imposed for one of the stresses, or a relation between the two stresses, from (1) and (2) the differential equation of the curve can be deduced which will satisfy the condition or relation. It is natural to inquire whether there is some shape which is preferable to all others, just as in the two-dimensional case of the arch the catenary is preferable.

For an element of an arch there is only one direct stress, and two equations of equilibrium. If it is assumed that there are no bending moments at any section, the direct stress, being the only unknown, can be eliminated from the two equations, and the result is the equation of the catenary. There is no other shape of arch (of uniform thickness) which will support its own weight without bending. The dome, however, presents no analogy to

[3] See F. H. Norton, Refractories, p. 275 *et seq.* for values of m appropriate to given base and height.

this. The assumption of no bending led to two equations (1) and (2), in terms of *two* direct stresses. The shape can be chosen and these stresses can be calculated, or in other words, any shape of dome can rest in equilibrium without the aid of bending stresses.

Since the avoidance of tensile stress, which is liable to occur as circumferential stress, is important, some interest attaches to the borderline case between domes with tensile stress and domes with compressive stress, and this will be the dome which has zero circumferential stress everywhere. The shape of this dome has recently been discussed,[4] but on the basis of an assumed analogy with the catenary, *viz.*, that the surface, inverted, and the catenary have each the lowest possible center of gravity for given area and given length, respectively. The problem is investigated directly from equations (1) and (2).

$$\text{Putting } q = 0 \text{ in (2) } \frac{d}{ds}(pr\cos\phi) = 0$$

which means that $pr\cos\phi$ is a constant, k.

Then

$$p = \frac{k}{r\cos\phi} \tag{5}$$

Substituting this to find the shape of the surface in (1),

$$\frac{d}{ds}(k\tan\phi) = \rho r$$

is obtained.

This is one form of the differential equation of the profile of the surface. Since $\frac{dr}{ds} = \cos\phi$ it may be written

$$\cos\phi\,\frac{d}{dr}(\tan\phi) = \frac{\rho}{k}\cdot r$$

or, carrying out the differentiation

$$\frac{d\phi}{dr} = \frac{\rho}{k}\cdot r\cos\phi$$

This is easily expressed in terms of the cylindrical coördinates, r and z. Thus, $\frac{dz}{dr} = \tan\phi$, so that $\frac{d^2z}{dr^2} = \sec^2\phi\,\frac{d\phi}{dr}$ and $\sec^2\phi = 1 + \tan^2\phi = 1 + \left(\frac{dz}{dr}\right)^2$. By means of these the equation is transformed into

$$\alpha\frac{d^2z}{dr^2} - r\sqrt{1+\left(\frac{dz}{dr}\right)^2} = 0$$

where α stands for k/ρ.

Putting $\frac{dz}{dr} = u$, it becomes

$$\alpha\frac{du}{dr} - r\sqrt{1+u^2} = 0$$

The solution of this which makes $u = 0$ at $r = 0$, an obvious requirement, is

$$u = \sinh\frac{r^2}{2\alpha}$$

[4] J. A. Fellows, *loc. cit.*

whence by a second integration

$$z = \int_0^r \sinh \frac{r^2}{2\alpha} \cdot dr$$

the lower limit of the integral being chosen to make z vanish with r. Replacing 2α by μ^2 the equation of the curve may be written in the form

$$\frac{z}{\mu} = \int_0^{r/\mu} \sinh \left(\frac{r}{\mu}\right)^2 d\left(\frac{r}{\mu}\right) \qquad (6)$$

The integral is simply a function of r/μ, and the equation may be compared to that of the catenary, which may be written

$$y/m = \cosh x/m$$

The parameter μ plays a part analogous to that of the parameter m. If a catenary is drawn with a definite value of m, the catenaries corresponding to other values of m are obtainable from it by simple magnification of ordinates and abscissas. So it is with the present curve and the parameter μ.

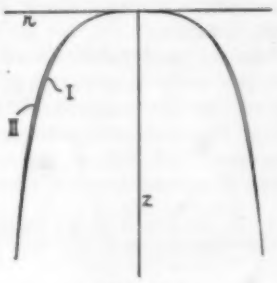


FIG. 5.

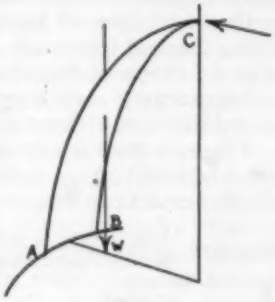


FIG. 6.

The curve I in Fig. 5 represents equation (6), and is therefore the shape of the section of the dome which is free from circumferential stress. The curve II in Fig. 5 is the curve, with the same base and height as I, obtained by J. A. Fellows[5] as the section of the surface of lowest center of gravity for a given area, and which he assumed to possess the property of zero circumferential stress. It will be seen that the difference between the two curves is definite, though slight, and this latter circumstance presumably accounts for the fact that the incorrectness of the curve II was not discovered by the test of comparing it with a suitably loaded string, described in his paper.

Absence of circumferential stress, however, implies an infinite compressive stress at the top of the dome, a fact which removes this particular form from the sphere of practical interest. A sector of the dome between two axial planes (Fig. 6) requires a moment about AB to balance the overturning moment of the weight W. Since there is no stress on AC or BC this moment must be supplied by a force at the vertex C. But at C the cross-sectional area is nil, so that an infinite stress is required there in

[5] *Loc. cit.*

order to furnish a finite force resultant. This is duly expressed by the stress formula (5), which tends to infinity as $r \longrightarrow 0$ and $\cos \phi \longrightarrow 1$.

V. Summary of Conclusions

The stresses in circular domes or kiln crowns of any shape, complete or open at the top, can be readily estimated if the walls are thin.

Circular openings in the top have a favorable effect on the stresses. If there is tension anywhere in the wall, it will be reduced by making the opening. Any weight placed on the rim of the opening has the opposite effect.

The stresses (due to gravity) will be proportional to the specific gravity of the material, so that in this respect the brick may be weak provided they are also light.

When it is desirable to mimimize or eliminate tension, the spherical dome or crown can be improved upon. If the angle subtended at the center of the sphere is greater than 104° there is tension below the level defined by this angle. The rule, apparently in common use, of making the spring one-quarter of the span, gives an angle of about 106°. Other shapes can be used to avoid tension altogether, as, for instance, the shapes generated by the revolution of parabolas and catenaries about their axes of symmetry. Conical forms are also free from tension.

There is no shape of dome which is obviously preferable to all other shapes, as a catenary arch is preferable to other arch shapes. Any dome can be in equilibrium without bending stresses, but the same is not true of arches. There is one shape of dome which ensures complete freedom from circumferential stress, tensile or compressive, but only at the expense of an infinite stress at the top. It is therefore of no practical interest.

Acknowledgment The author is indebted to A. E. R. Westman of the Ontario Research Foundation for reading the original manuscript and suggesting various improvements.

Ontario Research Foundation
Toronto, Canada

A LOW-TEMPERATURE COMPARATOR FOR COEFFICIENT OF EXPANSION OF CERAMIC BODIES*

By H. E. Davis

ABSTRACT

The following paper describes the design and operation of a simple device for determining the coefficient of linear expansion of fired clays or body mixtures between room temperature and 300°C, in view of predetermining their adaptability to a satisfactory glaze fit.

I. Introduction

An apparatus for the measurement of linear coefficient of expansion in a comparatively low-temperature range should be much simpler to construct and operate than the intraferometer usually employed for this purpose, but should also be usable in much higher temperature ranges.

II. Description of Apparatus

The entire apparatus is very simple and consists of a well-insulated cylindrical furnace for heating the specimen, the movement of which is measured by an Ames dial separately mounted. The furnace is built from a length of wrought-iron pipe, 4 inches internal diameter, with 2 caps. A cylindrical fireclay resistance furnace shell, internally wound, and having an inside diameter of $1^1/_4$ inches, is centered in the pipe and packed with shredded magnesia pipe covering, the insulation being approximately $1^1/_2$ inches thick. One of the pipe caps is screwed to a steel base with $^1/_8$ inch of asbestos paper between, and is equipped with a small steel cone $^1/_4$ inch in diameter at the base, and $^1/_4$ inch high, for the purpose of centering the specimens. The other pipe cap has the threads removed in a lathe so that it slides freely over the top of the furnace. This cap has two holes, one for a cork and thermometer and the other just large enough to allow free movement to a small steel pin which forms the connection between the specimen and the Ames dial. The furnace is mounted on a brick pier abutting a brick wall through which the mounting for the dial is fastened. Electric current for the heating element flows through resistance coils and a rheostat to permit proper control of the temperature increase.

Figure 1 shows the entire construction and manner of setting up. The dissipation of heat from the base plate into the brick pier, and thence to the brick wall supporting the Ames dial is so insignificant as to be entirely negligible.

III. Preparation of Specimen

Samples to be tested may be especially prepared by rolling out a piece of plastic clay into a bar about 13 inches long, plus shrinkage allowance, and not over 1 inch in diameter, or they may be cut from commercial ware with a silicon carbide or similar abrasive saw. Specimens are squared off exactly to 12 inches in length. A conical hole is chipped in one end with a sharp pointed tool to engage the small steel cone in the bottom of the furnace. The top end is grooved with an abrasive saw for approximately 3 inches of the length to provide room for the thermometer. A properly

* Presented at the Annual Meeting, American Ceramic Society, Pittsburgh, Pa., February, 1933 (Terra Cotta Division).

prepared piece fits loosely within the heating chamber, so as not to have any direct contact, but only with a small fractional part of an inch clearance all around.

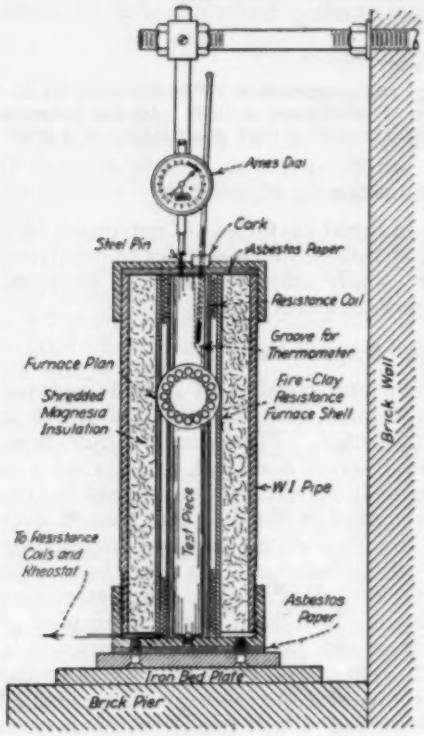


FIG. 1.

IV. Operation of Comparator

The furnace is free to be moved about on the brick pier, but the Ames dial is held rigidly in place, being adjustable in a vertical line only. This permits quick removal of the specimen after a test has been completed. The specimen to be tested is placed in the heating chamber and the top cap slid into place. The cap is adjusted so that the thermometer is inserted in the prepared groove, and the steel pin put in place to transmit the movement of the specimens to the Ames dial. The entire furnace is then moved under the Ames dial which is lowered onto the steel pin with a slight compression. The gage used for this purpose is an Ames dial gage No. 50, reading $^{20}/_{1000}$ inch per revolution. Each small division on the face registers $^{2}/_{10,000}$ inch and each $^{1}/_{10,000}$ inch is easily estimated. The apparatus is allowed to stand for 15 or 20 minutes before the current is turned on to allow complete equalization of the inside temperatures. Initial readings are taken at room temperature and heating started at full resistance to maintain a very slow rise. Normal room temperature varies between 24°C and 28°C, and readings are taken every 20°C increase, up to a total rise of 200°. The rate of temperature increase is maintained at slightly more than 1° per minute, the total time being about 3 hours. The temperature is held at the high point for at least 15 minutes to insure uniform heating of the specimens.

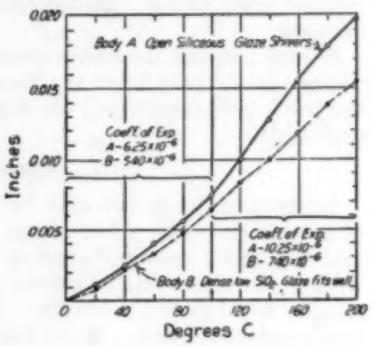


FIG. 2.

Careful observation has shown that specimen and furnace increase in temperature with no appreciable difference.

The coefficient of expansion is calculated by dividing the length increase in inches by the product of the temperature rise and the original length in inches.

Example

Length of sample	12 in.
Temperature rise	200°C
Length increase	0.0174 in.

$$\text{Coefficient of expansion} = \frac{0.0174}{200 \times 12} = 0.00000725 \text{ or } 7.25 \times 10^{-6}$$

Three bars cut from different pieces of commercial ware showed a maximum variation of 3%. In nearly all specimens tested, a considerable difference is noted in the coefficient determined on the first and second 100° temperature rise as shown by the typical curves in Fig. 2. The coefficient in all cases is higher in the higher range.

V. Conclusions

Although the apparatus described can not possibly be as scientifically accurate as the one developed by C. J. Kinzie and C. H. Commons, Jr.,[1] the results obtainable are quite satisfactory for comparative purposes. It offers (1) a simple method for determining the safe limits of variation for body mixtures, (2) the probable behavior of individual clays when introduced into a body, (3) the effect of additions of various fluxing or nonfluxing ingredients to any particular mixture, and (4) the effect of different firing treatments; all in relation to the linear coefficient of expansion. It is entirely probable that bars could be cast of glazes or engobes and determinations made on these, although it is an open question whether or not the factors obtained would be any true indication of their behavior when applied as a ceramic finish to a clay body.

FEDERAL SEABOARD TERRA COTTA COMPANY
WOODBRIDGE, NEW JERSEY

[1] See "A Method for Determination of the Coefficient of Expansion," *Jour. Amer. Ceram. Soc.*, **16** [1], 1–5 (1933).

MECHANICS OF ENAMEL ADHERENCE, VIII*

(A) Apparatus for Firing Enamels under Accurate Control of Temperature, Pressure, and Atmosphere

(B) Studies in Firing Enamels under Reduced Pressures

By R. M. King

ABSTRACT

The desirability of firing enamels under accurately controlled conditions has, in general, been recognized. The author has made a study of enamel firing under varying pressures and atmospheres (oxidizing, reducing, and neutral) as well as with accurately controlled temperatures. A special apparatus, which is described, was developed for this purpose and some results of these studies under reduced pressure are given and analyzed. This analysis reveals some basic causes of gas defects in enamels.

Part A

I. Description of Apparatus

Several investigations on firing enamels in various gases have been reported in the literature. These, including those of the writer,[1] however, have left something to be desired. In most of these reports it has been pointed out that the gas concentration was not sufficiently near 100%. Then too, the test pieces in many cases were so small as not to permit accurate conclusions. The temperature in most cases was carefully controlled, but little, if any, work has been published on results of enamel firing at diminished pressure, *i.e.*, below atmospheric pressure.

To control all these variables more carefully the apparatus shown in Fig. 1 was developed. Figure 2 shows curves with corresponding temperatures inside and outside of the quartz thermocouple protection tube and also the firing schedules subsequently employed in Part B of this paper.

With this apparatus a desired firing schedule can be reproduced within ±15°F at the finishing temperatures, and pressures as low as one millimeter can easily be obtained and held throughout a reasonable length of time. Although the apparatus has not been used above atmospheric pressures or filled with various gases, it was designed for such pressures and for gas concentration of 99.99% or greater.

(1) Procedure (1) When firing in air, all inlets and outlets were opened and the ground joint was closed.

(2) When firing in vacuum, all inlets and outlets including ground joints were closed, the pump was started, and the apparatus was evacuated to a pressure of 3 to 1 millimeters.

(3) When firing in gas other than air, the apparatus was completely evacuated and gas was allowed to flow in. This gas was pumped out and the operation was repeated until the desired concentration was obtained.

(4) When pressures greater than atmospheric were desired, the ground joint and outlets were closed and gas was forced in at gas inlet (7), Fig. 1.

---

* Presented at the Annual Meeting, American Ceramic Society, Pittsburgh, Pa., February, 1933 (Enamel Division).

[1] W. C. Rueckel and R. M. King, "Effect of Composition and Firing Atmosphere on the Adherence of Ground-Coat Enamels," *Jour. Amer. Ceram. Soc.*, **14** [10], 782–88 (1931).

Part B

I. Firing Studies under Reduced Pressures

A preliminary series of tests were made on a series of enamels (Table I) to determine their behavior with various firing procedures. These procedures, enamels, and fired characteristics are given below, and Fig. 3 shows the fired characteristics obtained for each enamel by the various firing procedures which follow.

(1) Firing Procedures

(1) In air by schedule No. 1 (Fig. 2).
(2) (*a*) In air by schedule No. 1 (to 1550°F in 5 minutes).
(*b*) In air by schedule No. 2 (to 1370°F in 2 minutes).
(3) At 1 to 3 mm. pressure by schedule No. 1 and allowed to cool at this pressure.
(4) (*a*) In air by schedule No. 1.
(*b*) At 1 to 3 mm. by schedule No. 2 and allowed to cool at this pressure.
(5) (*a*) At 1 to 3 mm. pressure by schedule No. 1 and allowed to cool at this pressure.
(*b*) In air by schedule 2.
(6) In air by schedule 1 and evacuation started when enamel had cooled to low redness.
(7) In air by schedule 1 and evacuation started immediately after removing furnace.
(8) At 1 to 3 mm. by schedule 1 with atmospheric pressure applied before furnace removed.
(9) Held at 1 to 3 mm. 5 minutes, then fired in air by schedule 1.
(10) (*a*) At 1 to 3 mm. by schedule 1, atmospheric pressure applied before furnace removed.
(*b*) In air by schedule 2.
(11) (*a*) Held at 1 to 3 mm. 5 minutes, then fired in air by schedule 1.
(*b*) In air by schedule 2.

NOTE: When (*a*) and (*b*) procedures are given, the two operations were carried out consecutively on the same piece.

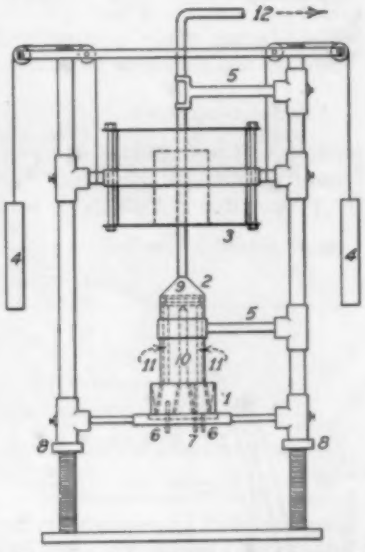


FIG. 1.—(1) Water-cooled metal quartz ground joint; (2) quartz firing chamber; (3) furnaces; (4) counterweights for furnace; (5) clamps; (6) tubes for water circulation; (7) gas inlet; (8) nuts for adjusting metal joint; (9) test piece and support; (10) quartz T. C. protection tube; (11) quartz tube supports; (12) to manometer and vacuum pump.

(2) Fired Characteristics

(1) Normal ground-coat appearance.
(2) Egg-shell surface.
(3) Numerous large bubbles; foaming.
(4) Extreme foaming.
(5) Marked pitting caused by partial healing of broken bubbles.
(6) Enamel separated in two layers: (1) a dark adhering layer, and (2) an upper slightly colored layer full of bubbles.
(7) Enamel free from bubbles as seen under the microscope, but subsequently chipped from the steel leaving clean metal surface.
(8) Enamel free from bubbles, no chipping from base.
(9) Enamel exhibits large unbroken, opaque bubbles. The enamel layer itself contains a large number of small bubbles.
(10) Enamel surface very rough due to the enlarged bubbles.

II. Tests on Electrolytic Iron

In another series of tests, vacuum-melted electrolytic iron was used as the metal base. A typical analysis of this iron is Mn 0.03, Si 0.03, C

0.005, P 0.008, S 0.016, and Fe 99.911. This metal was pickled according to usual procedures, but evacuated for ten minutes at 100°C before the enamels were applied to remove any occluded hydrogen. The absence of

TABLE I

COMPOSITION OF ENAMELS

Materials	Commercial Enamel (composition unknown) (c)	Enamel Letters (a)	(b)	(d)	(e)	(f)	(g)
Borax		33.00	33.00	33.00	33.00	33.00	33.00
Feldspar		28.50	28.50	28.50	28.50	28.50	28.50
Quartz		19.50	19.50	19.50	19.50	19.50	19.50
Fluorspar		5.00	5.00	5.00	5.00	5.00	5.00
Soda ash		7.50	7.50	7.50	7.50	7.50	7.50
Soda nitrate		5.00	5.00	5.00	5.00	5.00	5.00
CoO		1.50*		0.50*			0.50
NiO				0.50*	1.50*		0.50
MnO				0.50*		1.50*	0.50

* Added as carbonate.

hydrogen is assumed, which assumption the author believes to be justified from available information. All of the enamels were fired on this metal by procedures (1) and (8), and enamel (*g*) was fired by all procedures except (10) and (11). The following is a summary of results:

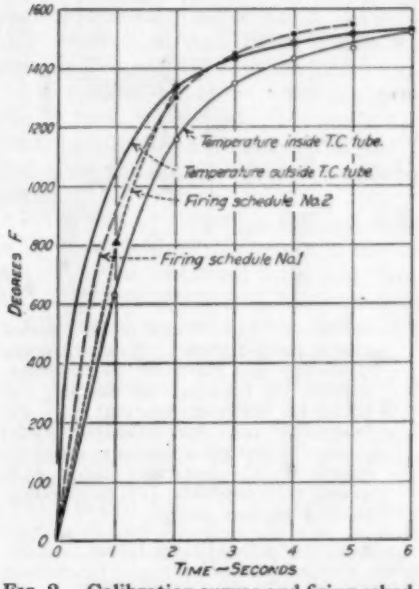


FIG. 2.—Calibration curves and firing schedules (values below 1000°F extrapolated).

(1) No enamel fired satisfactorily on electrolytic iron by normal procedure (1). The surfaces varied from slightly rough in the case of the commercial enamel (*c*) to marked "foaming" in the case of zero enamel (*b*). Examination of all but the (*b*) enamel under the microscope revealed the internal appearance of an overfired ground coat on enameling iron.

(2) In each case when enamel was fired *in vacuo* (procedure 8) the appearance was the same as when fired on ingot iron, but at this writing none of the enamels has chipped off as in fired characteristic (7).

III. Discussion of Results

This discussion will be given from the viewpoint of (1) gas defects in enamels and (2) mechanics of enamel adherence.

(1) Gas Defects in Enamels The presence of gas bubbles in enamels has been generally recognized, but it seems to have been assumed by some that their source was the metal base or mechanically entrapped air. It is true that some metals, notably steel, contain marked quantities of gases. Hayes, Canfield, and McGohan[2]

[2] A. Hayes, J. J. Canfield, and G. W. McGohan, "A Mechanism of Black Speck Formation of Ground Coat," *ibid.*, **15** [6], 338–44 (1932).

give the value of 0.0008% for hydrogen in a good grade of enameling stock. Baker[3] found that steel, when heated *in vacuo*, yielded 0.53 to 1.40 cubic centimeters per gram of steel, the greater part of the gas being hydrogen and carbon monoxide. Washburn and his co-workers[4] found that even the best optical glasses contained a certain amount of gas. The gas content of the glasses investigated varied from 0.2 to 2.0 times the volume of the glass, or from 20 to 200% by volume, measured under standard conditions. The gases found in glass were usually CO_2, O_2, SO_2, and H_2O vapor.

EXPERIMENT: Small pieces of ground-coat frits fired *in vacuo* by schedule No. 1 on platinum and fused quartz, which had been previously heated *in vacuo*, swelled to several times the original volume.

These experiments, and the fact that fired ground coats contain large quantities of gas bubbles, are sufficient evidence to establish the presence

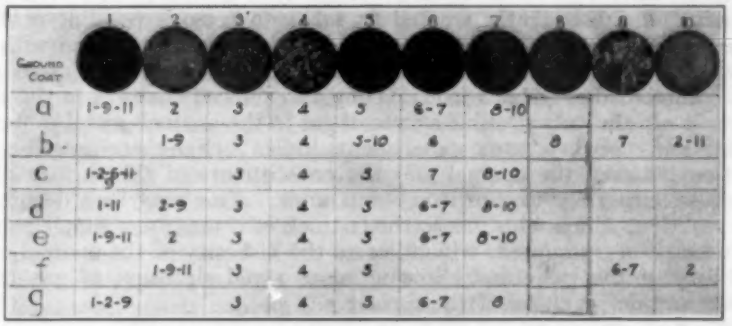


FIG. 3.—Fired characteristics. *Note:* Numbers in body of chart refer to firing procedures listed in text.

of gas in enamels. This gas may be CO_2 from carbonates, O_2 from nitrates, H_2O vapor from combined water in the borax and clay of mill charge, and fluorine or volatile fluorides from fluorides in frit. That these latter are evolved was demonstrated by the marked etching of the quartz firing chamber.

That the gas present in the enamel layer might be a primary cause of defects, for example, blistering, boiling, and reboiling, seems to have been overlooked by enamel men in favor of (1) air entrapped during application or firing, (2) a reaction between enamel and metal base, or (3) gases from the metal. Yet it seems more reasonable to charge the former cause with the primary rôle of causing gas defects and to assign a possible secondary rôle to entrapped air and to gases occluded in the metal.

Since the enamel contains a large number of small gas bubbles, these must be recognized as a potential source of gas defects. Any agency that brings about movement of these bubbles toward the surface may cause gas defects. If they do not burst they may cause blistering or boiling, or if they burst and do not heal they may cause pitting.

[3] Baker, *Trans. Faraday Soc.*, **14**, 228–31 (1918–19).

[4] E. W. Washburn, F. F. Footitt, and E. N. Bunting, "Dissolved Gases in Glass," Univ. Ill., Eng. Expt. Sta. *Bull.* No. 118 (1920).

Gas defects from gas in the enamel may be produced in several ways: (1) by movement of bubbles when reheated,[5] (2) by the action of small bubbles as nuclei for the formation of larger bubbles, (3) by action of small, dispersed solid particles as nuclei for the formation of larger bubbles, and (4) by adjustment to accommodate gas that may be evolved from the metal base.

EXPERIMENT: To a piece of good steel stock there was applied by spraying a regular commercial ground coat. This piece was heated gradually to 200°C at a pressure of 2 mm. for 15 minutes to remove entrapped air and water of hydration. It was then slowly heated to a temperature (previously determined) at which the enamel was healed over and then cooled at 2 mm. pressure. The surface of this piece had the appearance of foam.

Hence when entrapped air is removed gas defects will be formed from gases in the frit. The experiment with firing enamels on fused quartz and platinum, described above, confirms this statement.

Experiments with vacuum-melted electrolytic iron, prepared in the usual manner and subsequently treated *in vacuo* to remove possible occluded hydrogen, showed that gas defects were much more pronounced with iron in which occluded gas was at least a minimum than in the case of first-class commercial enameling iron. They also showed that gas in the metal base was not the only possible source of gas in the enamel–metal system.

The results of these same experiments indicate that there must be some reaction between the enamel and the constituents of the surface of the iron base, either the iron or iron compounds. This may be a decomposition reaction, which adds gas to the enamel, or it may be a simple solution of iron or iron compounds which lowers the viscosity of the enamel or the solubility of the gas, thus allowing more rapid diffusion of gas to the surface and deformation of the surface.

EXPERIMENT: A regularly prepared commercial ground coat was applied to a piece of sheet platinum and fired as per schedule No. 1. Under the microscope the enamel layer showed normal structure of enclosed bubbles. Repeated heating and cooling failed to produce blisters through coalescence of the small bubbles.

Thus all the single sources of gas have been relieved of the sole responsibility for gas defects; hence in the usual sheet-steel ground coat they must be associated with the action of the iron–enamel system. The presence of the gases does not necessarily portend a gas defect, but any disturbance of the equilibria governing these gases may cause a defect. Confirmation of these conclusions were made as follows:

EXPERIMENT: A piece of ingot iron wire was placed on a piece of platinum, covered with a regularly prepared ground coat, and fired as per schedule No. 1. Microscopic examination showed that in the vicinity of the wire the bubbles had become much larger and had migrated toward the surface, indicating that the presence of iron or iron oxide is a factor in causing gas defects.

EXPERIMENT: A piece of steel was enameled by regular procedures and small chips were broken from it by bending. These chips were placed on a piece of platinum and fired first by schedule No. 1 and then by schedule No. 2. The pressure at which the enamel began to swell was determined. The following data were obtained when the same procedure was used with frit for comparison: (1) pressure for fired enamel, 11.4 cm. and (2) pressure for frit, 7.1 cm. This shows that the viscosity of enamel fired on steel is lower than that of the enamel frit.

[5] Because of (*a*) a lowering of the viscosity of the enamel, (*b*) a lowering of solubility of gas in enamel by solution of constituents of the surface of the metal base, and (*c*) a reduction of pressure on enamel.

EXPERIMENT: A piece of commercial steel enameled *in vacuo*, cooled in air (procedure 8), and given the Canfield reboiling test did not "reboil," while the same steel and same enamel did "reboil" if the enamel was fired normally. Enamels fired by procedure (8) contained a few microscopic bubbles.

(2) Enamel Adherence (1) Enamels containing manganese oxide and no adherence-promoting oxide, *i.e.*, the white base ground coat, when fired on commercial steel by normal enameling procedures showed a marked tendency to separate from metal, at least from one side, shortly after cooling. When fired on electrolytic iron, these enamels foamed badly but did not flake off. When fired *in vacuo* on commercial and electrolytic iron and cooled at atmospheric pressure, these enamels adhered nicely and showed no tendency to flake off. When fired *in vacuo* and cooled *in vacuo*, these enamels on cooling separated from the ingot iron base in large areas.

(2) Enamels containing cobalt and nickel oxides, when fired by normal methods, adhered well to both commercial and electrolytic iron, but when electrolytic iron was enameled the gas defects were so marked that it was difficult to obtain a satisfactory surface. When fired *in vacuo* and cooled at atmospheric pressure, these enamels flaked from commercial steel in 24 hours, but did not flake from electrolytic iron on long standing. Photomicrographs and polished sections showed almost no dendrite development when fired on commercial steel and moderate development on electrolytic iron. When fired and cooled *in vacuo*, these enamels on commercial steel separated into two layers. In the case of electrolytic iron, the enamel foamed badly but there was no marked separation into layers.

It is possible that when firing *in vacuo* true results are obtained from coefficient of expansion differentials unmodified by the presence of gas bubbles, and this may explain the flaking of the cobalt oxide ground coats from commercial steel. Yet in the light of the following data on coefficient of expansion it is difficult to explain why a ground coat flakes from the enameling iron but does not flake from the electrolytic iron.

	Coeff. Linear Expansion[6] (0–500°C)
Av. enameling stock	14.2×10^{-6}
Enameling iron (99.90 Fe)	14.4×10^{-6}
Vacuum electrolytic iron (99.95 Fe)	14.1×10^{-6}
Pure iron	14.2×10^{-6}
Commercial ground coats	11.5×10^{-6}

It was pointed out above that enamels fired *in vacuo* contained few or no dendrites when fired on commercial steel, and only a moderate amount when fired on electrolytic iron.

It was also observed that cobalt and nickel oxide ground coats, when fired under certain conditions in which vacuum is involved, separated into two layers. The lower or adhering layer was very thin with no bubbles but contained dendrites, while the upper layer contained numerous gas bubbles (see firing characteristic (6) Fig. 3).

These latter observations, coupled with the fact that ground coats which did not contain cobalt and nickel oxides separated directly from steel and that such enamels did not contain metal dendrites, give more actual evidence for a theory to explain the marked adherence of cobalt and nickel

[6] International Critical Tables, Vol. II, pp. 459, 471, 472.

oxide enamels than has heretofore been given. This, however, seems to be a special case of adherence.

Available evidence indicates that there is an adherence between enamel and metal due to the inherent attractive forces. When enamels or enameling conditions do not form metal dendrites or allow them to form, the differential expansion between steel and enamel causes the enamel to overcome the inherent attractive forces normal to the interface and also, in some cases, to overcome the elasticity imparted by gas bubbles, thus separating from the metal. In the case of electrolytic iron, the fundamental attractive forces plus the moderate amounts of dendrites seem to resist the strains set up by differential expansion. Apparently, the fundamental attractive forces are sufficient to resist the expansion differentials in case of the base enamel fired *in vacuo*.

IV. Summary and Conclusions

(1) An apparatus has been described which can be used for firing enamels in various gases at pressures as low as 1 to 3 millimeters and under accurate temperature control up to 1600°C.

(2) A study of enamels fired with this apparatus shows (*a*) that the enamels contain large quantities of dissolved and dispersed gases which are a potential source of gas defects; (*b*) that the solution of iron or iron oxide in enamels tends to cause migration of these bubbles to the surface and cause gas defects; and (*c*) that when fired *in vacuo*, with certain other conditions carefully controlled, enamels containing cobalt and nickel oxides will separate directly from the steel. In this case the enamel contains few or no dendrites of iron. Under other conditions the application of a vacuum will separate such enamels into two distinct layers; the layer left attached to the steel contains dendrites while the detached layer has normal ground-coat structure. When fired under similar conditions, white base enamels show reverse tendencies. These facts indicate that metal dendrites are responsible for the marked adherence of cobalt and nickel oxide enamels to enameling steel. In other cases inherent attractive forces seem to be powerful enough to resist strain of differential expansions and to prevent chipping of enamel from steel.

Acknowledgments This investigation was carried out in the Ceramic Department of the Ohio State University, supported partially by the Engineering Experiment Station of the University and by a donation from the Republic Steel Corporation. Acknowledgment is also made of valuable suggestions by W. H. Bennett of the Physics Department in connection with design of apparatus, and of photomicrographs by George Spencer-Strong.

A NEW LEPIDOLITE DEPOSIT IN COLORADO*

By Edwin B. Eckel

ABSTRACT

A newly discovered pegmatite deposit near Ohio City, Colorado, is chiefly lepidolite, massive topaz, beryl, and albite, with some samarskite and columbite. Three parallel pegmatite dikes, each about 11 feet thick and 300 feet long, cut black schist. The minerals are banded parallel to walls, with the following succession from walls to center; fine-grained albite and quartz, large plates of lepidolite with crystals of topaz and beryl, fine-grained lepidolite, and lamellar albite. An estimate of the bulk percentage of the various constituents leads to the belief that at least several thousand tons of each of the commercially valuable minerals await mining.

I. Introduction

An extensive deposit of lepidolite, that should compete favorably with the lithium deposits of South Dakota and New Mexico, has been recently discovered in west central Colorado. Much of the potential value of the deposit lies in the fact that its exploitation will yield large tonnages of such by-products as albite, beryl, and massive topaz.

The present description is based on observations made during two brief visits that covered a period of three days during the fall of 1932. On one of these trips the writer was accompanied by his colleague, T. S. Lovering, whose wide knowledge of the pre-Cambrian geology of Colorado aided greatly in the examination.

Note: Practically all of the known lithium-bearing area is controlled by William Disberger of Pitkin, Colorado, and O. F. Werner of Ohio City, Colorado, to both of whom acknowledgment is due for many courtesies and for permission to examine and describe the deposit. E. P. Henderson of the U. S. National Museum kindly checked the mineral determinations.

II. Geography

As shown in Fig. 1, the deposit is about 2 miles southwest of Ohio City and 17 miles due east of Gunnison, lying in Sections 3, T. 49N., R. 3E., and 34, T. 50N., R. 3E. The Pitkin branch of the Denver and Rio Grande Western Railroad Company, which connects with the east-west narrow gage line at Parlin, 277 miles west of Denver, is only a mile distant. Connection with standard gage lines is made at Salida (eastbound) or Montrose (westbound). The district can be reached over good automobile roads either from Salida or Gunnison.

The northern part of the lepidolite-bearing area is shown on the topographic map accompanying the Colorado Geological Survey report on the Gold Brick District[1] but the deposits were unknown when that report was made. The topography is of moderately low relief, and consists of rounded hills drained by perennial streams. The chief deposit of lepidolite, as shown in Figs. 2 and 3, crops out on a fairly steep hill about one mile east of Quartz Creek and the Pitkin-Parlin road, and about 700 feet above them. The climate is mild during the greater part of the year. Though the principal vegetation in the immediate vicinity of the deposit is sagebrush and

* Published by permission of the Director, U. S. Geological Survey, the Colorado State Geological Survey Board, and the Colorado Metal Mining Fund.

Received March 9, 1933.

[1] R. D. Crawford and P. G. Worcester, "Geology and Ore Deposits of the Gold Brick District, Colo.," Colo. Geol. Surv. *Bull.* **10,** 116 pp. (1916).

grass, sufficient aspen and red spruce for all timbering requirements can be found on nearby hills. Abundant water for mining or milling purposes is supplied by Quartz Creek.

III. General Geology

All the known lithium mineralization occurs in pegmatite dikes in schists close to their contact with an intrusive mass of coarse-grained granite. The schists are black, thinly laminated, and consist chiefly of biotite or hornblende. They strike in general N. 10° W. to N. 45° W. and dip steeply eastward, although in places the dip is vertical or even overturned.

The granite, which is southwest of the schist body, and whose contact is roughly parallel to the schistosity, is coarse-grained, pinkish, and somewhat porphyritic. It strongly resembles the well-known Pikes Peak granite, and is tentatively correlated with it. Near its border the granite contains numerous inclusions of schist and a marked gneissic structure be-

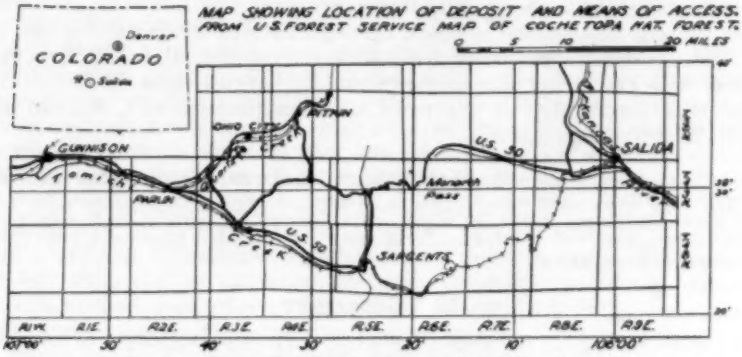


FIG. 1.—Map showing location of lepidolite deposit.

comes evident. Both granite and schist are cut by a number of parallel pegmatite dikes, which strike in a general northeasterly direction, but have variable dips. The dikes are commonly composed of coarsely granular quartz, microcline, albite, and muscovite, with a little biotite and magnetite. Although there is no definite evidence that the lepidolite pegmatites are related to the granite, the parallelism of all the dikes in the area, and the fact that the granite is of the type associated with the same general kind of pegmatite mineralization in other parts of Colorado, strongly suggest that the lithium-bearing pegmatites are genetically connected with the intrusion of the granite mass.

IV. The Lepidolite Deposits

The largest deposit of lepidolite is covered by two unpatented claims known as the Brown Derby Group. Although the existence of lithium mineralization was known in the district as early as 1910 the Brown Derby deposit was not discovered until the summer of 1930.

On the Brown Derby Group are three parallel pegmatite dikes 75 feet apart, each about 11 feet thick, that are traceable for a quarter mile or more. The outcrops show strong lepidolite mineralization for a distance

of about 300 feet along the strike. The dikes dip from 20 to 30° southeast and strike N. 40° E., but as they cut across a steep westerly slope the apparent trend is more northerly than northeasterly.

The contacts of the pegmatite dikes with the schist are sharply defined and the wall rocks do not show the metamorphism that commonly attends the formation of such deposits. The minerals in the lepidolite-bearing dikes are arranged in definite bands, much like those of metalliferous veins. This banding is so pronounced and the tendency to comb structure so strong that it is difficult to imagine any other mode of emplacement for the dikes than simple fissure filling by mobile solutions. Figure 4 shows this banded relationship. It seems to be fairly constant throughout the length of the lepidolite-bearing part of the dikes. Some evidence of partial replacement of the earlier minerals by later ones has been noted but conclusions as to the bearing of the mineral sequence on the genesis of the

FIG. 2.—General view looking east from the main Pitkin-Parlin road. The Brown Derby lepidolite-bearing dikes crop out on the far hill just below the sky line. The outcrops in the foreground are coarse-grained granite and those in the background are fine-grained black schist.

lepidolite and associated minerals must be left for further field and laboratory study.

V. Minerals of the Deposits

(1) Lepidolite The lepidolite ranges in size from fine-grained masses resembling pink soapstone through the more typical medium-grained crystalline aggregates, to large "books" up to 6 inches in diameter and 2 or 3 inches thick. The color varies from white to deep lavender, with intermediate shades of gray, yellow, or pink. The large plates are of considerable mineralogical interest, as such development of lepidolite is rare.

(2) Albite Albite, or soda spar, is exclusively of the pure white lamellar cleavelandite variety. It is associated with lepidolite and minor amounts of quartz, but in most places the minerals are segregated into separate masses that vary from a few inches to several feet across. This relationship should facilitate hand sorting of the ore, as the lepidolite tends to blast out in large lumps on account of its toughness, leaving the more brittle albite almost free of admixed lepidolite.

(3) Beryl Hexagonal crystals or irregular masses of beryl are found throughout the length of the dikes, and are commonly associated with bands of coarse-grained lepidolite. The largest single mass so far uncovered is about 3 feet in diameter and possesses the beautiful blue-green color of aquamarine, but most of the beryl is light yellowish green, white, or light pink. The last two types can be distinguished from massive quartz in the field only by their somewhat distinctive luster and by hardness tests. Beryl also occurs in a number of the other pegmatite dikes in the area, but has little commercial significance there as the dikes contain too much quartz and are usually too fine grained to permit ex-

FIG. 3.—Closer view of the Brown Derby deposits. The parallel pegmatite dikes in schist extend diagonally from upper left to lower right. The Brown Derby dikes are indicated by the arrow. The dikes in the foreground contain feldspar, quartz, mica, and some beryl, but no lepidolite.

ploitation either for feldspar or mica, and the small amount of beryl would not justify mining it alone.

(4) Topaz Topaz has occasionally been found in several of the somewhat unusual pegmatite dikes associated with pre-Cambrian rocks in Colorado, but never in large or abundant crystals. In the lepidolite dikes near Ohio City, however, topaz occurs in relatively large amounts. The rough crystals have an elongated prismatic form with poor terminal faces. Most of the individual crystals are several inches in diameter, but crystals a foot or more across and several feet long are not uncommon. The basal cleavage is distinct but not as perfect as in most topaz, due probably to the enormous number of liquid inclusions within the crystals. Like beryl, the topaz is characteristically associated with bands of coarse-grained lepidolite.

(5) Columbite Columbite has been found in a few places as wedge-shaped crystals several inches in diameter. F. G. Hills of the Colorado School of Mines Experimental Plant kindly made a partial

FIG. 4.—Cross-section of one of the lepidolite-bearing dikes, exposed in open cut. The pick handle is about 3 feet long. *L*, fine-grained lepidolite, essentially free from albite; *L-A*, mixture of fine-grained lepidolite and lamellar albite; *Lp*, large plates of lepidolite. A definite band of this type shows about 2 feet from the footwall of the dike; *A*, lamellar albite, essentially free from lepidolite; *Q-A*, comparatively fine-grained mixture of quartz and albite; *Q*, white, massive quartz; *T*, large crystals of topaz.

analysis of the mineral and reports that it contains approximately 72% columbium oxide and 6% tantalum oxide. This would exclude it from commercial consideration unless columbium, like tantalum, takes its place as a useful metal.

(6) Samarskite Samarskite occurs sparingly throughout the Brown Derby dikes as small, rounded, dark brown grains embedded in lepidolite, but attains a much greater development on the nearby J. B. W. claim, located on one of the smaller outlying lepidolite-bearing dikes. It has not been found in large masses and would have no commercial value unless tabling or flotation methods were adopted for the separation of the other minerals of the deposit. Samarskite does, however, have scientific interest of some magnitude, as from a determination of the lead-uranium ratio the age of the deposit can be calculated. A large sample of lepidolite rich in samarskite was kindly donated by the owner, O. F. Werner, and after concentration by A. J. Weinig, Director of the Colorado School of Mines Experimental Plant, about half a pound of the mineral was forwarded to the Committee on the Age of the Earth of the National Research Council for further work. Their results are not yet available but will be awaited with great interest by mineralogists and geologists.

(7) Tourmaline Tourmaline occurs sporadically throughout the deposit. In places it is the ordinary black variety and fills cracks in the earlier minerals or develops as tiny rods in clear quartz, but most of it is a delicate pink, similar to that of the well-known rubellite from Pala, California. All crystals uncovered so far have been so cracked as to make them worthless for gem material. Many of the crystals, which may attain a thickness of one-half inch or more, are bent and warped, showing the effects of movement subsequent to the formation of the dikes. The mineral is at present of no commercial importance.

(8) Other Minerals Microcline, or potash feldspar, is not abundant in the lepidolite-bearing part of the Brown Derby dikes, but in a small offshoot from one of them there is a considerable amount of it. No lepidolite was observed in this offshoot. White massive quartz with some muscovite and a few accessory minerals make up the rest of the deposit. Amblygonite and spodumene, usually found with lepidolite, have not been observed.

From observations of the outcrops and all the meager openings that have been made on the Brown Derby dikes the following rough estimate of bulk percentages of the chief constituents of the lepidolite deposit has been made:

	(%)		(%)
Quartz	40	Microcline, muscovite, and minor accessory minerals	5
Albite	30	Beryl	4
Lepidolite	15	Topaz	6

An estimate of the possible tonnage is admittedly speculative, but it seems safe to infer that the three chief dikes, each with an average width of 11 feet and a length of 300 feet, will show much the same type of lithium mineralization as observed at the surface to a depth at least equal to half the length of the outcrop. These estimates lead to the belief that several thousand tons of each of the commercially valuable minerals await mining.

Over an area of about $1^1/_2$ square miles lithium mineralization is to be found. Although none of the other known exposures would seem to be as extensive as the Brown Derby this widespread distribution suggests the

possibility that other large bodies may be uncovered by additional prospecting.

VI. Developments and Conclusions

The developments on the property to date include only shallow pits and small open cuts. These have served to prove the extent of lithium mineralization along the outcrop, but before the deposit is developed on a larger scale its extent in depth must be ascertained more definitely. Underground mining methods will necessarily be employed for extraction of the minerals as the low angles of dip of the dikes would soon cause the overburden to become too great for open-cut work.

That the potential value of the deposit depends almost entirely on securing a market for most of the products seems clear. Lepidolite, though at present in little demand by the glass and ceramic industry, seems to be the most important mineral in the deposit, and a market for it would be essential to successful development. Albite, while not as favored in western feldspar markets as is the ordinary potash feldspar, would undoubtedly be a by-product of importance, as the lepidolite should bear most of the cost of mining and sorting.

Beryl occurs in sufficient quantity to be of interest, and might conceivably rank next to lepidolite in value. Efficient sorting of the beryl will probably offer some difficulties, however, on account of its similarity to some of the quartz and feldspar.

Topaz has little or no use at present, but there are indications that it may find considerable use in the manufacture of electrical porcelain, as it has a very low coefficient of expansion, with a correspondingly high resistance to rupture.[2] As the topaz now used experimentally is for the most part imported from India, a deposit of this mineral in Colorado may have potential value. Columbite and samarskite can only be looked on as minor by-products, although at present prices they would at least carry the cost of hand sorting.

U. S. Geological Survey
Golden, Colorado

[2] A. B. Peck, "The Behavior of Unstable or Monotropic Forms in the System Alumina–Silica and Related Systems," *Jour. Amer. Ceram. Soc.*, **16** [2], 68–75 (1933).

STRENGTH AND DURABILITY TESTS OF MORTAR-MIX MORTAR*

By M. G. Spangler

ABSTRACT

The continued use and development of finely ground raw clay, or mortar-mix, as a plasticizer for cement-sand mortars has led to further and more comprehensive physical tests of this product. This paper gives a brief description and the results of tension, compression, freezing and thawing, bond strength, and absorption tests recently conducted on samples of mortar-mix from two clay products plants in Iowa. These tests are compared with similar tests of hydrated lime when used as a plasticizer. They confirm a previous conclusion that there is no substantial difference in the physical properties of sand-cement mortars when equal percentages of mortar-mix or hydrated lime are used as the greasing agent.

I. Introduction

The use of finely ground clay, commonly called mortar-mix, a as plasticizing agent for cement-sand mortars has persisted and developed beyond the experimental stage and it is now a recognized commercial product. It has enjoyed a favorable acceptance by brick masons as a usable and effective plasticizer, and it can successfully compete with other similarly used greasing agents on an economic basis.

The engineer, architect, and building owner are vitally interested in the strength and durability of mortars in which mortar-mix is used and the purpose of this paper is to present the results of some recent and hitherto unpublished physical tests which give an indication of various strength properties of such mortars. The results of tensile tests on mortars containing mortar-mix have been published[1] and since that time compression tests, freezing and thawing tests, bond-strength tests, and absorption tests have been conducted.

As there are no commonly accepted basic test specifications for cement mortars, the procedure in this work has been to make a comparison between the behavior of mortar-mix mortars and hydrated-lime mortars. Hydrated lime has been used so long as a plasticizer and the strength and durability characteristics of cement mortars resulting from its use as an admixture are so well known that it seems to provide an excellent basis of comparison.

The plan of all these tests, including the tensile tests previously mentioned, has been to adopt a standard mortar composed of 1 part cementitious material (cement plus admixture) to 3 parts sand by volume. This standard was varied by substituting various percentages from 0 to 50 (by volume) of the cement by the admixtures (1) ground clay or mortar-mix and (2) hydrated lime. The cement and sand were taken from the same source for all the specimens in a given test and may be considered constant for the various mixes. The mixing water was held substantially constant for the two admixtures, but the mortars containing the larger percentages of admixture required more water than the straight cement-sand mix to make the mortars workable. All of the specimens were cured for 24 hours in a moist closet, removed from the molds, and stored in a moist room for the remainder of the curing period of either 7 or 28 days as the case might be.

* Received January 28, 1933.

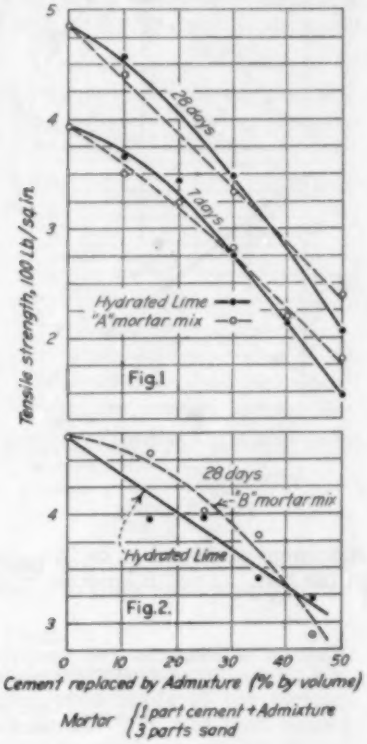
[1] M. G. Spangler, "Ground Clay as Plasticizing Agent (New Use for Clay)," *Jour. Amer. Ceram. Soc.*, **13** [12], 927–28 (1930).

Although the Division of Tests of the Iowa Engineering Experiment Station has conducted tests on mortar-mix manufactured by a half dozen or more different clay products companies in Iowa, the detailed results for only two of these products will be reported in this paper. They are typical of all the mortar-mixes tested and are selected mainly because of the completeness of the tests which have been performed on them. For convenience, they are designated as "A" mortar-mix and "B" mortar-mix. It should be understood that these tests do not necessarily provide a basis of comparison between the two mortar-mixes, because the tests on each product were conducted at different times using different cement, sand, and hydrated lime. The only valid comparison which can be made is that between the mortar-mix mortars and the hydrated-lime mortars in a given test.

II. Tension Tests

Tensile tests were conducted on standard briquets having a cross-sectional area of one square inch. In the tests of the "A" mortar-mix, which have been reported previously as noted above, ten specimens were made of each mortar, five of which were tested at 7 days and the remaining five at 28 days. The results of these tests are shown in Fig. 1, each plotted point being the average strength of five specimens.

For the "B" mortar-mix the same procedure was followed, except that the 7-day tests were eliminated. The results of these tests are shown in Fig. 2.



FIGS. 1 AND 2.

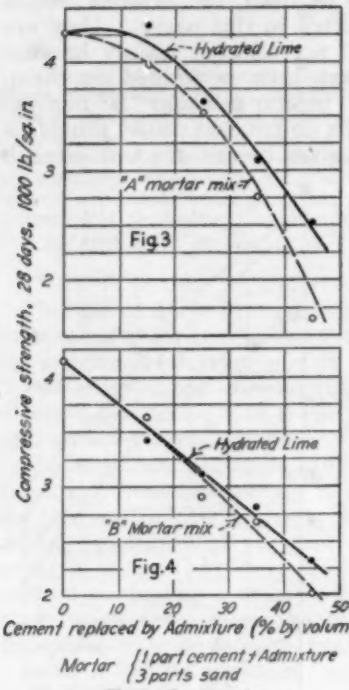
III. Compression Tests

Compression tests were made on $2^1/_4$ by $4^1/_2$-inch cylinders, having a cross-sectional area of 3.98 square inches. Five specimens of each mortar were made, all of which were tested at 28 days. The compressive strengths of these mortars are shown in Figs. 3 and 4. Here again each point represents the average strength of five specimens.

IV. Freezing and Thawing Tests

The purpose of this test is to give some indication of the durability of the mortars and to show their resistance to alternate freezing and thawing. It is used as a standard test for Portland cement concrete drain tile and certain clay and shale structural units which in service are subjected to the action of the elements. The general procedure is to place pieces of

the unit being tested in a shallow pan of water and to subject the pan and its contents to a specified number of cycles of alternate freezing and thawing. The specimens are examined to determine the extent of any superficial disintegration or cracking. For extra quality concrete drain tile, the standard requirement specified by the A. S. T. M. is 48 cycles, and this number was arbitrarily adopted as a minimum for these mortar tests.


Hydrated Lime
"A" mortar mix
Fig.3
Hydrated Lime
"B" Mortar mix
Fig.4
Compressive strength, 28 days, 1000 lb/sq in
Cement replaced by Admixture (% by volume)
Mortar {1 part cement + Admixture / 3 parts sand

FIGS. 3 AND 4.

Mortar specimens containing various percentages of the mortar-mix and hydrated-lime admixtures as in the other tests were made up in the form of $4^1/_2$- by 9-inch cylinders. These were cured for 28 days and then sawed into 4 slices, each about $2^1/_2$ inches thick. These slices were then subjected to the freezing and thawing cycles. In general, each cycle lasted about 24 hours, the specimens being placed in the freezer in the evening and then removed to a warm moist room in the morning.

The specimens made from the "A" mortar-mix and their companion mortars in which hydrated lime was used were subjected to 60 cycles and at the end of the treatment they were all free from perceptible superficial disintegration or cracking. All of the specimens appeared to be in as good condition as they were at the beginning of the test. The "B" mortar-mix specimens were subjected to 48 cycles of

TABLE I

RESULTS OF FREEZING AND THAWING TESTS ON MORTAR SPECIMENS CONTAINING "B" MORTAR-MIX AND HYDRATED LIME

Mortar { Cement plus admixture 1 part / Sand 3 parts

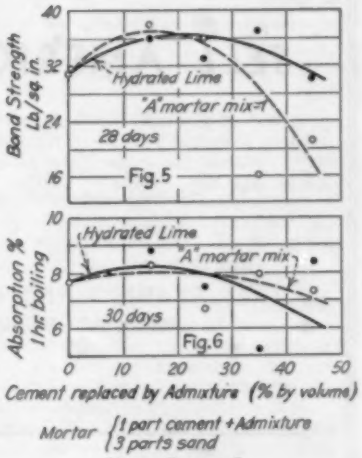
Specimen No.	Per cent cement replaced by admixture	Admixture	Condition of specimen at conclusion of 48 cycles
1	None	None	No evidence of disintegration
2	15	Mortar-mix	" " " "
3	25	" "	" " " "
4	35	" "	" " " "
5	45	" "	Partially disintegrated; began at 36th cycle
6	15	Hydrated lime	Readily broken with hammer
7	25	" "	" " " "
8	35	" "	Partially disintegrated; about the same as No. 5
9	45	" "	Completely disintegrated; pieces crumbled badly; began at 30th cycle

alternate freezing and thawing. Some of these showed evidence of partial disintegration as is summarized in Table I.

V. Bond-Strength Tests

The purpose of the bond-strength tests was to check the ability of the mortar-mix mortar to adhere to fired clayware after the mortar had set up. The plan followed in this test was to make up a series of mortars containing various percentages of the mortar-mix and the hydrated lime in addition to a straight cement-sand mortar, just as had been done in the previous physical tests. Three pairs of brick were then plastered together flatwise with each mortar. After setting for 28 days in air, each brick of a pair was placed in an improvised clamp and a direct pull normal to the plastered faces of the brick was applied until the bond between the mortar and one of the brick was broken. The total pull required to break the bond divided by the area of the face of the brick in contact with the mortar is reported as the bond strength of the mortar in pounds per square inch.

The results of these tests which were conducted on the "A" mortar-mix only are given in Fig. 5 and show satisfactory uniformity except in the case of the mortars in which 35% and 45% of the cement was replaced by mortar-mix. In the case of these two mortars, the bond strength fell off materially and the total pull on the individual specimens varied widely, indicating that the results may not be representative. These two mortars should be checked further before definite conclusions are drawn as to their bond strength.



FIGS. 5 AND 6.

VI. Absorption Tests

One hour boiling absorption tests were made on mortars containing the "A" mortar-mix. Cylinders, 4½ by 9 inches, were made of the various mortars, which were cured in a moist room for 30 days and then sawed into three equal slices. These slices were dried to constant weight, boiled in water for one hour, and weighed again. The percentage increase in weight of the boiled specimens over their dry weight is reported as the absorption of the mortars. These percentages are shown in Fig. 6.

VII. Conclusions

Mortar-mix, when used to replace up to 45 or 50% (by volume) of the cement, produces mortar at least as strong and as durable as mortars in which equal percentages of hydrated lime are used. The tests also serve to emphasize the necessity of holding the amount of admixture in mortars to the least percentage which will produce a workable mix.

IOWA ENGINEERING EXPERIMENT STATION
IOWA STATE COLLEGE
AMES, IOWA

BUY AMERICAN-MADE WARE

Good! but not enough

SELL AMERICAN-MADE WARE

(1) by showing ware unexcelled in esthetic and utilitarian values

(2) by establishing sound economic philosophy of giving business to prospective customers

---

June 12, 1933	Dedication of New York State College of Ceramics, Alfred, N. Y.
June 26–30, 1933	Century of Progress Meetings, Stevens Hotel, Chicago, Ill.
February 11–16, 1934	Thirty-Sixth Annual Meeting, American Ceramic Society Hotel Netherland Plaza, Cincinnati, Ohio

CERAMIC ABSTRACTS[1]

Compiled by the

AMERICAN CERAMIC SOCIETY

Ross C. Purdy, Editor

Abstracters: A. Ally, C. R. Amberg, J. B. Austin, A. A. Ayars, R. Barta, M. H. Berns, W. W. Braun, L. T. Brownmiller, W. M. Cohn, P. E. Cox, R. H. Ewell, J. L. Gallup, C. G. Harman, F. G. Heck, R. A. Heindl, E. B. Hewitt, G. M. Hutt, S. Kondo, M. V. Kondoidy, A. Kurchler, W. Lerch, J. T. Littleton, W. W. Meyer, R. G. Mills, S. I. Perkal, J. G. Phillips, E. P. Rexford, W. E. Rice, D. E. Sharp, G. R. Shelton, H. H. Stephenson, J. G. Tolpin, E. J. Vachuska, H. F. Vieweg, M. J. G. Westfeldt, A. E. R. Westman.

Vol. 12 **May, 1933** **No. 5**

Abrasives

Size control of abrasive powders. Henry R. Power. *Metal Cleaning & Finishing*, **5** [1], 40–41 (1933).—To measure the fineness of sub-screen sizes of abrasive powders several indirect methods have been used, *viz.*, consistency, apparent density, light-dispersing power, rate of solution in a mixture of sodium carbonate and sodium hydroxide, the absorption test, dispersion of X-rays, or the effect on the stress strain of rubber compounded with the powder. The best method is based on the rate of settling of a powder in a liquid medium, the rate of settling obeying Stoke's law. By fixing the conditions under which the particle settles, a sample can be matched accurately. E.J.V.

Grinding allowances. Anon. *Machinery* [London], **36**, 757 (1930).—Grinding allowances are determined primarily by the turned finish, the method of heat treatment, and the amount of work necessary to remove the excess of metal by grinding. The factor first mentioned depends on the tolerance of the finished size and on the type of machine used, which is largely a question of economics. Variations of size due to heat treatment are rarely consistent and vary from one workman to another. F.G.H.

Polishing aluminum. Anon. *Machinery* [London], **38**, 338 (1931).—Aluminum oxide abrasives, with the addition of oil or grease, should be used for rough polishing operations on aluminum. Tripoli, followed by lime, produces a high finish. Rouge should be avoided as it tends to become embedded and imparts a reddish tinge to the metal. F.G.H.

Notes on grinding aluminum and magnesium alloys. Anon. *Machinery* [London], **39**, 521 (1932). F.G.H.

Lapping of tungsten-carbide tools. H. J. W. *Machinery* [London], **37**, 245 (1930).—A lapped cutting edge on a tungsten-carbide tool will last from 2 to 4 times as long as a plain ground edge. The dull appearance of a surface lapped with a less expensive abrasive than diamond dust is shown by photomicrographs to be due to shallow pitting as compared with fine parallel scratches; it does not indicate an unsatisfactory finish. In the method developed by the Carborundum Co., Ltd., a fine finish is produced by lapping with grade R40 silicon carbide fine, first on a cast-iron disk and then on a wooden disk; a surface speed of 900 to 1200 ft./min. is recommended. F.G.H.

Chromium-plated gages. Anon. *Machinery* [London], **38**, 533–34 (1931).—Directions for grinding are included in this description of the method of manufacture of chromium-plated gages. During the final grinding the wheel must not be too hard, otherwise the plate may peel and blister. F.G.H.

Polishing corrosion-resistant alloys. Henry R. Power. *Metal Cleaning & Finishing*, **5** [2], 85–86 (1933).—Some metallurgical characteristics of the new stainless steels that affect polishing results are pointed out in this article. E.J.V.

Science perfects bell making. J. B. Nealey. *Foundry*, **61** [2], 17 (1933).—In the tuning of a large bell, metal is ground from the interior of the bell by various types of motor-driven grinding wheels. Illustrated. F.G.H.

Polishing times. L. E. B. *Machinery* [London], **37**, 140 (1930).—It is difficult

[1] The abbreviation (*C.A.*) at the end of an abstract indicates that it was obtained from *Chemical Abstracts* by coöperative agreement.

The bold-face number following the journal name is the volume, the issue number is in brackets followed by the page numbers, then the year in parentheses.

to estimate the time required for an operation such as polishing, in which the skill of the individual workman plays a large part. If a curve be plotted showing the time required on a variety of such work as a function of the surface areas of the pieces, the time which will be taken on a piece of a new type may be estimated closely by interpolation.
F.G.H.

PATENTS

Separation of grain particles from a bonded mass. OTIS HUTCHINS (Carborundum Co.). U. S. 1,898,371, Feb. 21, 1933.

Grinding apparatus. F. G. MUSHENO (Allegheny Steel Co.). U. S. 1,898,786, Feb. 21, 1933. J. H. HOERN (Wilcox-Rich Corp). U. S. 1,900,112, March 7, 1933.

Buffing wheel blank plies. HARRY ZIMMERMAN. U. S. 1,899,252, Feb. 28, 1933.

Machine tool. F. E. STRATTON (Diamond Machine Co.). U. S. 1,899,362, Feb. 28, 1933.

Method and apparatus for grinding and polishing materials. L. E. HOWARD (Simonds Saw and Steel Co.). U. S. 1,899,463, Feb. 28, 1933.

Worm grinding machine. F. A. WARD (Gear Grinding Machine Co.). U. S. 1,899,654, Feb. 28, 1933.

Gear wheel grinding machine. R. J. BULLOWS (Gear Grinding Co., Ltd.). U. S. 1,899,793, Feb. 28, 1933.

Abrasive disk. W. C. HAPP (Studebaker Corp.). U. S. 1,899,959, March 7, 1933.

Method of making abrasive product. J. N. KUZMICK. U. S. 1,900,386, March 7, 1933. An abrasive composition comprises abrasive granules and synthetic resin wetted with benzaldehyde, the proportion of the benzaldehyde being low and of the order of 1½% by weight of the composition when using a fine grain of abrasive.

Automatic feed for grinding or abrading machines. VAN NORMAN MACHINE TOOL Co. Brit. 387,436, Feb. 15, 1933.

Art and Archeology

Engraving and frosting glass by chemical means. JEAN DARIC. *Céram. Verrerie*, No. 832, pp. 555–56; No. 833, pp. 625–27 (1931).—In the engraving of glass by chemical means the surface to remain unattacked is covered with a wax applied in some volatile solvent such as benzene. The piece is then immersed in a hydrofluoric acid bath in which the unprotected glass is attacked and dissolves in the bath. After thorough washing the wax is dissolved or saponified by sodium hydroxide. In frosting, the pieces are placed in a bath of hydrofluoric acid which has been partly neutralized by sodium or ammonium hydroxide. Microscopic crystals are formed on the surface which disperse the light. Detailed procedures for engraving and frosting, including bath compositions, are given. See also *Ceram. Abs.*, **11** [8], 436 (1932). M.H.B.

Photography on enamels, glass, and porcelain. A. GRANGER. *Céram. Verrerie*, No. 841, pp. 361–63; No. 843, pp. 469–71 (1932).—G. discusses the production of photographic images on enamels, porcelain, and glass. The process is essentially the same as the one ordinarily used on paper except that metals less alterable than silver are used. For enamels, it consists in sensitizing a film of collodion with a solution of glue or honey containing an alkaline bichromate. This solution is able to fix the vitrifiable powder used. After removal of excess powder the thin sheet of collodion is placed on the enamel and is fused in place, the organic material being burned off. The processes for porcelain and glass vary only slightly from this in details. Directions for carrying on the process, including the preparation of solutions, are given. See also abstract by Schiffner, *Ceram. Abs.*, **12** [1], 4 (1933). M.H.B.

Pictures built with bits of enamel. ANON. *Popular Sci. Monthly*, **122** [4], 26–27 (1933).—The complete procedure involved in the making of a mosaic enamel panel, 76 ft. long and 14 ft. high, for Radio City, New York, is described and illustrated.
F.G.H.

Sand and air. MILAN TEN EYCK. *Glass Ind.*, **14** [3], 35–39 (1933).—Equipment and methods used in producing sandblasted design decorated work on glass, wood, tile, marble, and metal are described. Particular attention is given to the miscellaneous materials and operations used in producing the designed sandblast, especially on glass. Illustrated. E.J.V.

Decorative glass wins new distinction. WALTER R. STOREY. *N. Y. Times Mag.*, pp. 12 and 18, Feb. 12, 1933.—The exhibition of Steuben Glass designed by Walter Dor-

win Teague and displayed at the Arden Galleries (New York) is described. See also *Ceram. Abs.*, **12** [2], 44 (1933). M.V.K.

China designs. ANON. *Arts & Dec.*, **38** [4], 38 (1933).—An Italian pottery after-dinner coffee service, an English china tea service, service plates, and relish dishes in great variety are described and illustrated. E.B.H.

Modern British pottery. P. COLNAGHI AND D. COLNAGHI. *Illus. London News*, **181**, 939 (1932).—The artists represented are Cardew, Dalton, Dunsany, Lily and Wilfred Norton, Gwendolen Parnell, and Phyllis Simpson. H.H.S.

Varma trinkar, hot drinks for chilly days. MARCIA MEIGS. *Arts & Dec.*, **38** [4], 21–23 (1933).—Unusual glasses for beverages are described and illustrated. E.B.H.

Product design for the market. R. F. ELDER. *Mech. Eng.*, **54** [8], 543–46 (1932).—Factors affecting the design of modern products are discussed. Glassware designs illustrate the article. F.G.H.

Ancient and modern pottery. ARTHUR W. LAMBERT. *Pottery Gaz.*, **58** [669], 358 (1933).—L. traces the development of pottery from the time when it was shaped by hand and baked in the sun. E.J.V.

Rogers' groups. CARL GREENLEAF BEEDE. *Christian Sci. Mon.*, **25** [48], 7 (1933).—"Rogers Groups" were pieces of statuary about 15 inches high that were quite common in American homes about fifty years ago. John Rogers, the maker, originally modeled them in clay but these disappeared and replicas made in plaster by use of gelatin molds are the survivors. Illustrated. E.J.V.

New light on Billingsley. WILLIAM H. TAPP. *Connoisseur*, **91** [377], 28–36 (1933).—This article traces the ceramic history of the Billingsleys, father and son, the latter, apprenticed to Duesbury in 1774, being the originator of the new style of flower painting on china. The Derby ewer is a good example, the rose work having the calyx petals laid back from the corolla, the thorning carefully done, and the greens metallic with warmth and depth. Many examples are shown with sample details. See also *Ceram. Abs.*, **12** [4], 139 (1933). E.B.H.

Antique art treasures. C. REGINALD GRUNDY. *Connoisseur*, **90** [375], 324–35 (1932).—Supplementing the list of ceramic features at the exhibition at Christies, a Chelsea tureen modeled as a boar's head (a *tour de force* of the red anchor period), a Nelson goblet, and some fine glass chandeliers are worthy of mention. Illustrated. E.B.H.

Some vases in the Hurlbutt Collection. FRANK HURLBUTT. *Connoisseur*, **91** [377], 14–19 (1933).—H. describes and illustrates English porcelain including vases which are elaborately decorated with molded and painted flowers and painted scenes and figures and jars and figure groups. E.B.H.

Silhouette portraits in the Royal collections. (MRS.) F. NEVILLE JACKSON. *Connoisseur*, **90** [367], 359–67 (1932).—The Jubilee silhouettes of George III, painted on English porcelain, were successors to the portraits of the Stuarts and of William and Mary in slip ware or on blue dash chargers. During the late 18th and early 19th Centuries the small kingdoms of mid-Europe produced pieces with silhouettes of the reigning families, from full services to simple mugs. Some factories seized the opportunity to decorate wedding gifts, etc. The Royal Warrant was issued to the Worcester Factory in 1789 after a visit from the King. E.B.H.

White gold of Meissen. HENRY ALBERT PHILLIPS. *Travel*, **60** [5], 22–25 (1933).—P. gives a brief history of the development of Meissen porcelain from the time of its discovery by Johann Friedrich Boettger in 1708 to the present. Boettger's secret lay in the fact that a perfect porphyry is indigenous to Saxony, and this material is an important ingredient in present-day Meissen porcelain. Illustrated. See also *Ceram. Abs.*, **11** [9], 497 (1932). E.J.V.

Pesaro, the city of majolica. GIAN CARLO POLIDORI. *Corriere Ceram.*, **13** [12], 435–39 (1932).—Historical notes on the accomplishments of the majolica workers of Pesaro are given. M.V.K.

Cyprus 4000 years ago. P. DIKAIOS. *Illus. London News*, **181**, 928–29 (1932).—Pottery representations of snake worship, etc., are reproduced. See also *Ceram. Abs.*, **11** [3], 152; [5], 288 (1932). H.H.S.

Excavations at Samaria. KATHLEEN KENYON. *Discovery*, **13**, 377–80 (1932).—The Anglo-Harvard expedition is adding substantially to the knowledge of Samaria in Biblical and Crusading times. H.H.S.

Submerged city in the Crimea. ANON. *Discovery*, **13**, 375 (1932).—Unusual interest has been aroused by the discovery, by submarine methods, of the fortified city of old Chersoneus, which was abandoned in the 2nd Century B.C. and rapidly submerged by the sea. H.H.S.

Maya religious art in Guatemala. T. GANN. *Illus. London News*, **181**, 1006 (1932).—At Tikal, discoveries of sculptures, cinerary urns, and figurines reveal the worship of the "Long-Nosed God," who was the god of earth, rain, and fertility. Three-dimensional reconstructions of Tikal have been made at the Buffalo Museum of Science. H.H.S.

Mystery of Luristan art. FREYA STARK. *Illus. London News*, **181**, 1054–55 (1932).—The Luristan region of Western Persia is bandit ridden, and the origin of its bronzes and pottery is not yet solved. 11 photographs. H.H.S.

BOOKS

Memoirs of the American Academy in Rome. Vol. X. ANON. 60 plates. 182 pp. American Academy in Rome, Porta San Pancrazio, Rome, Italy, 1932. Reviewed in *Times Lit. Supp.*, **32**, 9 (1933).—A catalog of the Greek vases in the Academy's Museum is included. H.H.S.

Old English Porcelain: The Lady Ludlow Collection. ARTHUR HAYDEN. John Murray, London. 41 color plates and 91 photogravures. Price 25 pounds. Edition limited to 100 copies. Reviewed in *Connoisseur*, **91** [377], 42 (1933).—Choice specimens of English ceramic art from 18 factories are described and illustrated. E.B.H.

PATENTS

Design for bottle. E. W. FUERST (Owens-Illinois Glass Co.). U. S. 89,300, Feb. 21, 1933.

Design for jug. E. W. FUERST (Owens-Illinois Glass Co.). U. S. 89,301, Feb. 21, 1933.

Design for bowl. D. A. JENKINS (D. C. Jenkins Glass Co.). U. S. 89,307, Feb. 21, 1933.

Design for bowl, dish, and cup. STEPHEN SLESINGER (Stephen Slesinger, Inc.). U. S. 89,360, 89,361, and 89,362, Feb. 28, 1933.

Design for cup. DAVID FISHER. U. S. 89,391, March 7, 1933.

Design for goblet. J. G. ROSSITER (Reynolds Spring Co.). U. S. 89,309, Feb. 21, 1933.

Design for glass bowl for semi-indirect illumination. GEORGE AINSWORTH. U. S. 89,327, Feb. 28, 1933.

Design for spudless closet bowl. M. D. HELFRICH. U. S. 89,343, Feb. 28, 1933.

Design for combined coffee maker and server. W. D. TEAGUE (Corning Glass Works). U. S. 89,364, Feb. 28, 1933.

Design for saucer. DAVID FISHER. U. S. 89,390, March 7, 1933.

Design for covered dish, etc. J. V. GODDARD (H. C. Edmiston). U. S. 89,396, March 7, 1933.

Design for glass jar. H. R. MCDONALD (Hart Glass Mfg. Co.). U. S. 89,403, March 7, 1933. FRASIER SMITH (Hazel-Atlas Glass Co.). U. S. 89,420, March 7, 1933.

Method of making transfer. R. G. TONGE. U. S. 1,899,066, Feb. 28, 1933.

Decalcomania transfer. F. A. EDGHILL (Rayner Decalcomania Co.). U. S. 1,900,048, March 7, 1933.

Cements

Exothermic effect on the formation of Portland cement clinker from clay, blast-furnace slag, and limestone. H. ELSNER VON GRONOW. *Angew. Chem.*, **46** [3], 68 (1933).—From the knowledge of the heats of solution of the raw materials or their components and from the specific heats, G. calculated the exothermic effects on calcining. Since the energy content of the clinker depends on composition and calcining, a "generally useful" number for the exothermic effect should not be quoted. L.T.B.

Recast analysis and its relation to the chemistry of Portland cement. VIII. Computation of Portland cement raw mixtures. LOUIS A. DAHL. *Rock Prod.*, **36** [2], 38–39 (1933).—D. illustrates algebraic and graphic methods of computing Portland cement raw mixtures. For Part VII see *Ceram. Abs.*, **12** [2], 45 (1933). W.W.M.

Hydration processes. RICHARD GRÜN. *Angew. Chem.*, **46** [3], 67 (1933).—The hardening of Portland cement depends on the precipitation of gels which later dry out and harden. G. has studied the energy which remains in hardened cement by determining how such cements react when hydrated a second and third time. Physical and

optical studies were made to determine how the second hardening proceeds and how the storage conditions affect the second hardening. The changes in compressive strength of rehardened Portland cement with and without additions of slag, sand, and trass lead to the conclusion that new compounds are formed between the trass and the cement which show a tendency to harden. By chemical tests G. determined how firmly the CaO is bound in rehardened cement. Differences were noted depending on whether a glassy slag was present. L.T.B.

Study of metallurgical Portland cement. III. P. DUMESNIL. *Rev. mat. constr. trav. pub.*, No. 280, pp. 8–10 (1933).—French and foreign cements are discussed. For Part II see *Ceram. Abs.*, **12** [4], 141 (1933). M.V.K.

Clay in concrete. D. A. PARSONS. Bur. Stand. *Jour. Research*, **10** [2], 257–73 (1933).—The replacement of 7½% of the volume of the sand by an equal volume of clay increased the compressive strength 1 to 37%. At 9 months the permeability was decreased; later it was increased both actually and relatively to that of the plain concrete without clay. The substitution of 10% of the volume of the cement, except for the first 2 or 3 months in the case of the ordinary Portland cement concrete, caused a decrease in strength of 0 to 10%. The slight permeability was not appreciably changed. The difference in absorption, permeability, and resistance to freezing and thawing between concretes which contained clay and those which did not was small. R.A.H.

Enamels

Some fusion properties of ground-coat enamels as influenced by composition. W. N. HARRISON AND B. J. SWEO. Bur. Stand. *Jour. Research*, **10** [2], 189–209 (1933).—The compositions of nine ground-coat enamels for sheet iron are varied within a region approximating commercial practice by substituting silica and feldspar, one for another, while the percentages of other ingredients remain constant, and by substituting boric oxide and sodium oxide, one for another, while the other constituents remain constant. In two other enamels the above-named fluxes vary as a unit against the two refractories as a unit. The fusion properties were studied through five different tests, *viz.*, (1) temperature of maximum heat absorption, (2) softening temperature as observed with the interferometer, (3) cone deformation temperature, (4) button deformation temperature, and (5) fusion block deformation behavior. The following conclusions, applicable within the limits of compositions studied, were drawn: (1) The increase of silica from 25 to 35% with simultaneous reduction of feldspar from 35 to 25% causes a moderate increase in refractoriness. The full 10% substitution raises the end temperatures of the different tests 10 to 15°C. (2) The increase of boric oxide from 13 to 19% with simultaneous reduction of sodium oxide from 17 to 11% causes an increase in end temperatures of the various tests which is marked in the region near 13% oxide and which becomes less perceptible as the boric oxide content approaches 19%. This diminution in effectiveness is most conspicuous in the tests involving no flow of the specimens, and becomes less prominent as the amount of flow involved in the respective determinations increases. (3) The reason that the diminution in the effectiveness of successive substitutions of boric oxide becomes less noticeable as the amount of flow involved in the respective determinations increases might be traced to the fact that variations in viscosity of enamels have more opportunity to influence the results of those tests which involve a greater flow of the specimens. (4) Since the tests were conducted on definite time-temperature schedules, the end temperatures of the respective determinations increased with the amount of flow involved. This effect places the determinations in the following order of increasing temperature: Maximum heat absorption temperature, initial deformation temperature as observed in the interferometer, cone deformation temperature, button deformation temperature, fusion block start temperature, and fusion block finish temperature. (5) In conducting tests for the purpose of correlating properties quantitatively with systematic variations in composition, it is desirable to avoid the "variable end-point" principle according to which all specimens are treated alike and the various degrees of effectiveness of the treatment in the respective cases are noted. (6) While the results of this study do not warrant the statement that any one of the described tests gives a truer picture of the behavior of the enamels in practice than another, they do indicate that the general pattern covering the results of all the tests, as outlined above in 1 and 2, is indicative of the relative behavior of the enamels in process of fusion on metal. R.A.H.

Adherence and reboiling of porcelain enamel. II. ANSON HAYES. *Ceram. Ind.*, **20** [2], 84–88 (1933); *Better Enameling*, **4** [2], 8–9 (1933).—H. discusses the mechanism

of applying ground coats which affects adherence. The discussion is divided into (1) cleaning of the metal, (2) characteristics of the enamel, *e.g.*, thickness of coat, and (3) methods of applying it, *e.g.*, dipping, spraying, and firing of enamel. Reboiling is associated with conditions which form stresses in enamel coats. For Part I see *Ceram. Abs.*, **12** [4], 144 (1933). W.W.M.

Adherence of light ground coat on sheet iron. EISENLOHR. *Emailletech. Monats-Blätter*, **9** [1], 1–6 (1933).—After discussing the chemical and physical aspects of ground-coat adherence to sheet iron, E. takes up the particular properties of each of the components of the ground-coat batch. A detailed description of several experiments run to determine the effect of various treatments of ground coats on their adherence is given with the following conclusions: (1) The adherence stability of the investigated light ground coats is influenced to a great extent by the time of grinding. An optimum is arrived at with a residue of about 30% on a 100-mesh screen. (2) Zirconium oxide fused in aids in the formation of the adhering layer and increases the stability against impact. (3) Firmus oxide as a mill addition aids the adherence, hinders the rusting, and is an excellent adjusting medium. (4) Borolith exerts a favorable influence on the elasticity. (5) Metal separation, according to Eyer, Jr.'s theory, can not be demonstrated. Should some such thing occur under singular circumstances, only secondary importance can be attached thereto. (6) Not only pickled but also unpickled sheet iron can be used with light ground coats. (7) The firing temperature and duration of firing have a great influence on the adherence, as has been shown in tests in factory furnaces. The light ground coat must be so adjusted that it can be fired in the same manner as a cobalt ground coat. E.J.V.

Adhering interval for ground-coat enamels. EISENLOHR. *Emailletech. Monats-Blätter*, **9** [2], 11–12 (1933).—The formation of the adhering surface is dependent on the composition of the ground coat. Next to the composition of the ground coat, for which the possibility of the formation of an adhering surface between the upper surface of the sheet metal and the ground-coat enamel compensates, are two factors which are to be considered in the phenomena of adherence: (1) firing temperature and duration of firing expressed in the viscosity of the molten ground coat, and (2) grain size determined by the fineness of grinding. Tests to prove these points are described and it is pointed out that overfiring should be avoided if the adhering surface is to be maintained. With a lower firing temperature a smooth ground coat is obtained and the furnace performance is increased. E.J.V.

Soda ash in foundry technique. N. L. EVANS. *Foundry Trade Jour.*, **47**, 331–37 (1932); *Times Eng. Supp.*, **31**, 249 (1932).—First used simply as a desulfurizing agent, Na_2CO_3 has been found to have a marked refining and degasifying action on metal producing sounder castings. The amount used is 0.5 to 1.0% of the weight of iron. 13 photomicrographs. H.H.S.

Control in spraying enamel slips. FRANK R. PORTER. *Ceram. Ind.*, **20** [2], 73–74 (1933).—The results show that savings can be made by reducing the atomizing air pressure to a minimum for good work, adjusting the spray width to suit the ware, using "maximum density" slip, and adjusting the enamel flow to suit the air pressure and work. W.W.M.

Application of Gardner mobilometer to enamel slip consistency studies and controls. II. G. H. MCINTYRE AND J. T. IRWIN. *Enamelist*, **10** [4], 26–32; [5], 28–30 (1933).—For original reference see *Ceram. Abs.*, **11** [9], 481 (1932). W.W.M.

Vitreous enameling materials and supplies. II. W. C. CUMMINGS. *Clay Prod. News*, **6** [2], 6–7 (1933).—C. continues with his discussion of enameling materials and supplies. Feldspar, filler for cast iron, fuel oil, frit, graining and marbleizing, magnesium carbonate, monel metal, neutralizers, oil soap, opacifiers, pebbles and porcelain balls, pickle pills, pyrometric cones, rubbing stones, sieves, scales, spray guns, soda ash, stencil metal, sponges, tin oxide, and wool dusters are discussed. For Part I see *Ceram. Abs.*, **12** [4], 144 (1933). W.W.M.

Sources of dirt in porcelain enameling. J. F. HUNT. *Enamelist*, **10** [5], 15 (1933).—Dirt particles in enamels are a source of much trouble. The causes are divided as follows: (*A*) In the raw material storage; (1) dust from uncovered frit bins, and opacifier and clay containers, (2) organic and magnetic particles from raw lump clay, (3) dust from sacks and barrels of materials as shipped in, (4) contamination of white frit with ground-coat frit due to not cleaning out hopper car or weighing container after each mill loading, and (5) particles of rubber from worn-out conduit hose. (*B*) From the ball mills; (1) iron particles from steel door frames and grinding heads, (2) black specks or chips from using dark flint pebbles in mills, (3) black specks from using dirty porcelain balls and mill linings, and (4) color contamination from grinding a white

enamel in a mill that has been used for a colored enamel. (*C*) Aging tanks or barrels not dustproof. (*D*) From the production floor; (1) rust particles from iron spray barrels and dip tanks, (2) rust particles from iron air lines and dirty spray guns, (3) iron particles from ragged edges of ware and weld splashes that get into dip tanks, (4) iron and rust particles ground off from overhead conveyers and falling on sprayed ware, (5) air contaminated with fine particles of sandblast sand, and (6) sand clinging to blasted ware. Remedies for each of these dirt sources are discussed. W.W.M.

Equipment for cleaning metal. XXV. R. W. MITCHELL. *Metal Cleaning & Finishing*, **5** [1], 31–35 (1933).—In discussing the procedure and equipment employed in the mechanical cleaning of metal parts, M. takes up tumbling, rolling, and barrel burnishing. Illustrated. For Part XXIV see *Ceram. Abs.*, **12** [3], 96 (1933). E.J.V.

Degreasing and cleaning. W. F. JESSON. *Jour. Inst. Metals*, **53** [1], x (1933).—J. surveys the various methods available for the cleaning of metals and advocates the use of trichlorethylene, C_2HCl_3, a commercially pure liquid specially stabilized to prevent decomposition when exposed to light and heat. F.G.H.

Speeding up drying in enamel plants. PH. EYER. *Emailletech. Monats-Blätter*, **8** [12], 91–93 (1932).—E. discusses the erection of waste-heat driers to utilize the heat from the enamel furnaces and to speed up the drying of the enamelware. Illustrated. E.J.V.

Manufacturing enameled sanitary ware. I. Foundry and enameling department. LOUIS WOLFF. *Better Enameling*, **4** [2], 13–14 (1933).—W. describes the processing of enameled sanitary ware in the foundry and in the enameling department. W.W.M.

Companies producing steel enameled sinks. ANON. *Ceram. Ind.*, **20** [2], 66–67 (1933).—Briggs Mfg. Co., Detroit, Michigan, and Youngstown Pressed Steel Co., Warren, Ohio, are selling one-piece, wet-process, enameled steel sinks. The former company is making two designs. W.W.M.

Porcelain enamel surfaces for turbine pumps. JOHNSTON PUMP CO. *Power*, **76** [6], 323 (1932).—Application of porcelain enamel for coating impellers or runners and bowls of deep-well turbine pumps is said to increase pump efficiency approximately 5% and to be completely acid-resistant and resistant to sand abrasion. F.G.H.

Porcelain enamel for modernization of stores. M. J. SALTZMAN. *Better Enameling*, **4** [2], 6–7 (1933).—Use of enamel for redressing store fronts is discussed. W.W.M.

Future of the porcelain enameling industry for the ceramic engineer. EMERSON P. POSTE. *Enamelist*, **10** [5], 22 (1933).—P. predicts a good future for the ceramic engineer in the enameling industry. W.W.M.

Contract or piece work in enamel plants. III. R. BECKER. *Emailletech. Monats-Blätter*, **8** [12], 93–94 (1932).—B. lists groupings of processes in enameling in several ways for the purpose of establishing pay rates per definite number of pieces. The classification for the firemen and helpers is also given with details as to the giving of bonuses. For Part II see also *Ceram. Abs.*, **12** [2], 47 (1933). E.J.V.

BOOKS

Cast Iron Enamel Defects, Their Causes and Prevention. (Gussemailfehler, ihre Ursachen und Verhütung.) WALTER KERSTAN AND OSKAR KERSTAN. Published by Emailwaren-Ind., Duisburg, 1932. 70 pp. 2.60 Rm. Reviewed in *Glashütte*, **63** [7], 115 (1933); *Emailletech. Monats-Blätter*, **9** [2], 14 (1933).—The book deals with (1) properties of cast iron, (2) enamel defects due to faulty cast iron or its structure, (3) ground enamel and its defects due to its composition, (4) defects in the enamel coat (wet and powder methods), and (5) influences of the refractory lining of the melting furnace. A review of literature on the subject is given. See also *Ceram. Abs.*, **11** [11], 553 (1932). M.V.K.

Stamping and Enamel Calendar for 1933. Published by Illustr. Ztg. fon Blech und Installation, Leipzig. 300 pp. 2.70 Rm. Reviewed in *Glashütte*, **63** [7], 115 (1933).—The first part deals with the stamping industry; the second (edited by W. Kerstan) discusses the enamel technique including the lastest researches in the field of the technique of glazes (melting, fritting, colors, opacifiers, etc.), properties, treatment, selection of raw materials, composition of enamels, manufacture, and refractories. M.V.K.

PATENTS

Zirconium oxide opacifier for enamels. LUDWIG WEISS. U. S. 1,881,303, Oct. 4, 1932.

Enamel decorating process. A. P. SCHULZ (Teller Stove Designing Corp.). U. S. 1,898,500, Feb. 21, 1933. The process of applying a decorated enamel finish to a sur-

face consists in first applying a base coating of enamel to the surface, drying the enamel, and then, before firing this coating, applying the coloring material thereto in dry form, fixing the dry coloring material, and then firing the coating to infuse the coloring material with the base coating.

Enamels on metals. IGNAZ KREIDL. Fr. 731,233, Feb. 10, 1932. Enamel is applied or fixed by fire on objects molded in Fe alloys containing metals or metalloids which provoke a passivity of the Fe. Alloys of Fe with Ni, Co, Mn, Cr, Cu, V, Zr, Sn, Zn, Ce, W, Mo, Si, etc., are suitable. (*C.A.*)

Blue enamel. BERNHARD F. W. ROSS. Ger. 558,551, May 20, 1930. A blue enamel reflector for giving daylight effects is prepared by adding Cr_2O_3 to the usual mixture of flux and blue Co and Cu pigments. (*C.A.*)

Glass

Constitution of glass. W. WEYL. *Angew. Chem.*, **46** [3], 68 (1933).—Physical-chemical methods to solve the problem of the constitution of glasses have given information as to the physical structure but lead to nothing definite as to the chemical nature of the glassforming molecule. The determination of the absorption spectrum of glasses seems to have filled the gap, however. For colored glasses there is an explanation of the dependence of color on the composition, the temperature, and on other factors. In glasses colored with Cr_2O_3 this relation has been solved. If the glass consists largely of acid oxides then the chromium enters into combination in the form of chromic compounds. If the glass contains basic compounds (alkalis) there is a possibility of the formation of chromates. Normal technical glasses contain both oxidation states. By adding arsenic the Cr^{+++} state is obtained exclusively. It is more difficult to obtain pure chromate glasses; in order to produce them melting must be done at an oxygen pressure of 250 atmospheres. The effect of additions of boric acid on the color of chromium glasses was studied. See also *Ceram. Abs.*, **12** [3], 99 (1933). L.T.B.

Can glass be considered a colloid? I. F. PONOMAREV. *Keram. i Steklo*, **8** [12], 11–12 (1932).—According to a number of investigators, glass can be considered a colloid. The characteristic feature of any colloid is its heterogeneity. Two conditions are essential for the colloid system, (1) a dispersion medium, and (2) a dispersoid. Colloid solutions are optically heterogeneous. Glass is optically homogeneous, this property being the basis of optics. Other investigators consider glass a mixture of silicates Na and Ca with SiO_2. Only the phenomenon of ruby glass (dispersed distribution of gold in glass) can be referred to as colloidal. M.V.K.

Physical and chemical methods for testing glasses in industrial laboratories. II. F. H. ZSCHACKE. *Glashütte*, **62** [35], 609–11; [37], 643–45; [38], 657–62; [40], 693–94; [41], 709–11; [42], 725–27; [49], 865–66; [51], 899–901 (1932).—Methods are described which are utilized for determining (1) deformation temperature of glasses with and without load according to Zschimmer and Schaller, (2) vitrification temperatures according to Eckert, and (3) temperatures of flow according to Weidert and Berndt, and Eckert. Behavior of glass when heated over a lamp and methods for testing it include (1) testing the workability of the glass, (2) tendency to become rough on heating, (3) discoloration, (4) capability of combining, and (5) ball testing. The density and thermal expansion of glasses were investigated by (1) determining the density according to Payne, and (2) testing the thermal expansion according to Sharp. Mechanical strength of glass and its testing on glass tubes, rods, and plates, determining impact strength according to the pendulum and free fall methods, testing the impact strength of safety glass, and testing the influence of weathering and light on safety glass are also discussed. For Part I see *Ceram. Abs.*, **11** [11], 556 (1932). M.V.K.

Behavior of heavy-metal compounds during melting of glass batches under strongly reducing conditions. I. Relative activity of several reducing agents. F. H. ZSCHACKE AND E. LINDBLAD. *Glastech. Ber.*, **10** [12], 634–43 (1932).—The relative reducing power of a number of reducing agents, as measured by their decolorizing action on manganese glass, is as follows in the order of diminishing strength: Al, Fe, $SnCl_2$, As_2O_3, C (as graphite), Zn, Mg, Sb_2O_3. All were employed in finely powdered form. Only the first three readily reduce MnO_2 to MnO. In each case only a small fraction of the reducing agent reacts with the oxidizing agent. The reducing power of the elementary reducing agents, with the exception of aluminum, is smaller in those cases where the heat of formation of the oxides is greater, but the exact nature of the relationship has not yet been determined. The reducing power of coal is less than that of graphite due

to the gases given off by the coal. The reducing power of As_2O_3 is much greater than that of Sb_2O_3 even though the heats of formation of the pentoxides from the trioxides are almost alike. This is probably due to a difference in the extent of dissociation of the pentoxides at high temperatures. Hydrogen, hydrogen sulfide, and sulfur dioxide have a reducing action when blown through the molten mass. Sulfuric acid has a much stronger reducing action when introduced into the melt by means of a porcelain or clay tube than when introduced through a quartz tube. Sodium sulfate, however, has an oxidizing action. Potassium permanganate requires three times as much reducing agent as does manganese dioxide. W.W.B.

Relation between rate of crystallization in the devitrification of English lead crystal glass and the potash content. W. HIRSCH. *Glastech. Ber.*, **10** [12], 625–34 (1932).—Five lead crystal glasses of the composition, 33 parts PbO, 67 parts SiO_2, plus 6 to 14 parts of K_2O, were made up of chemically pure raw materials in platinum crucibles. Each glass was analyzed. Crystals were then grown in 0.05 gram samples of these glasses in a Zschimmer and Dietzel devitrification apparatus. The Tammann crystallization rates were measured microscopically by means of an ocular micrometer. The same primary crystal phase, cristobalite, was common to all five glasses. It was formed only on the border between the glass phase and the air, but not on the border between the glass phase and enclosed air bubbles. The equilibrium temperature for the crystals separating out on the surface, the rate of crystallization, and the temperature of maximum crystallization were determined. The following practical conclusions are drawn from the results: (1) On falling below the potash content stipulated by the Zschimmer rule the per cent K_2O should equal (76% PbO) $\times$ 0.27, in the case of these glasses, 11.6% K_2O. The equilibrium temperature and the temperature of maximum crystallization rate sink almost proportionately with the potash content. The rate of crystallization also increases with decreasing potash content. (2) The smaller the potash content, the greater is the amount of devitrification that takes place. (3) The amount of crystallization taking place at any particular temperature within a certain length of time and the grain size of the crystals may be calculated. Tables of data and charts have been prepared for this purpose. (4) Due to the volatility of PbO and K_2O, continued heating increases the tendency to devitrify. The effects of variation in potash content on the durability and toughness of the glass must also be taken into consideration. W.W.B.

Changes in various glasses on irradiation. JOSEF HOFFMANN. *Glastech. Ber.*, **11** [1], 11–17 (1933).—The changes occurring in arsenic, cerium, iron, sulfate, selenium, and cadmium glasses on irradiation with the β and γ radiations of radium were studied. The decolorization, the pigments formed, and the effect of subsequent heat treatment were investigated. W.W.B.

Absorption of silver by glass. I. WESTERMANN. *Z. tech. Physik*, **13** [12], 617 (1932).—This is a discussion of the paper by Guentherschulze and Mohr (*Ceram. Abs.*, **11** [12], 611 (1932)). Investigations of kaolin-silver mixtures at temperatures of more than 400° prove that silver oxide may be absorbed by the silicate. This will explain the mechanism of absorption of silver by the glass as observed by Guentherschulze and Mohr. W.M.C.

Temperature dependence of absorption in colored glasses and its significance. G. KILTZ. *Angew. Chem.*, **46** [3], 68 (1933); for abstract see *Ceram. Abs.*, **12** [3], 99 (1933). L.T.B.

Behavior of glassforming oxides under high oxygen pressures. H. MÖTTIG. *Angew. Chem.*, **46** [3], 68 (1933); for abstract see *Ceram. Abs.*, **12** [4], 145 (1933). L.T.B.

Influence of some metallic oxides on the coloration and light transmission of glass. I. K. FUWA. Presented at the Jan., 1933, meeting of the Society of Glass Technology. Abstracted in *Glass*, **10** [2], 61 (1933). G.R.S.

Dilatometric measurements on glasses. H. SALMANG. *Angew. Chem.*, **46** [3], 68 (1933); see following abstract. L.T.B.

Dilatometric measurements in the glassy state. O. KOERNER, H. SALMANG, AND W. LERCH. *Sprechsaal*, **65** [52], 925–26 (1932); see also *Ceram. Abs.*, **12** [4], 146 (1933). W.W.B.

General discussion on "Specifications for raw materials in the glass industry." W. E. S. TURNER. Presented at the Jan., 1933, meeting of the Society of Glass Technology. Abstracted in *Glass*, **10** [2], 62–63 (1933). G.R.S.

Homogenization of the mixture. III (continued). Influence of moisture in sand. F. ECKERT, S. DEL MUNDO, AND F. H. ZSCHACKE. *Sprechsaal*, **65** [48], 858–59; [49], 875–76; [50], 891–93 (1932).—The influence of the degree of moistness of the sand on the degree of homogeneity obtainable and the time required therefor in sand-soda-lime mixtures were studied. (1) More than 15% of moisture in the sand causes the

mixture to become lumpy; lime increases this tendency. (2) Up to about 5% of moisture in the sand, the addition of water increases both the speed of mixing and the degree of homogeneity obtainable, but after this point both decrease. (3) Increasing the moisture content decreases the dust loss. The mixture obtained with sand containing 15% moisture is practically dustless. (4) Premixing of the sand and soda before adding the lime decreases the total time required for mixing. Even frozen moist sand may be employed in this manner. (5) The danger of separation or de-mixing of the mixture on transporting or storing decreases with increasing moisture content. Mixtures containing sand with 10% moisture are stable even on prolonged agitation or shaking. For first part of III see *Ceram. Abs.*, **12** [3], 102 (1933). W.W.B.

Notes on manufacture of special glasses. XII. Elimination and prevention of seed in colorless glass. ANON. *Glass*, **10** [2], 52–56 (1933).—A review of the work given on the subject of seed prevention and elimination is outlined. A general program to be followed in the investigation of seed problems is drawn up. For Part XI see *Ceram. Abs.*, **12** [4], 149 (1933). G.R.S.

Examination of stones in glass. THEODOR WEISZ AND LEON TREINEN. *Glastech. Ber.*, **10** [12], 646–47 (1932).—Methods for differentiating between various kinds of stones in glass and their more accurate examination by means of thin sections are described. W.W.B.

Defects in glass. JACQUES WOLF. *Céram. Verrerie*, No. 841, pp. 371–73; No. 842, p. 423 (1932).—W. outlines in detail all the more common defects found in glass and discusses each briefly. They may be classified under the following headings: (1) defects in vitreous mass, including (*a*) defects in physical-chemical properties, (*b*) lack of homogeneity, (*c*) stones, and (*d*) bubbles; (2) defects in finishing, as occurring in (*a*) fabrication, (*b*) grinding, or (*c*) polishing; and (3) defects in fabrication in general. M.H.B.

Glass claimed to be four times stronger than ordinary glass. LONDON CORRESPONDENT. *Ceram. Ind.*, **20** [3], 132–35 (1933); *Nat. Glass Budget*, **48** [44], 3 (1933).—Pilkington Brothers, Ltd., England, will feature a new glass called "Armourplate." They do not possess the rights to market it in the U. S. National Physical Laboratory tests show that whereas a steel ball weighing 1.68 lb. will break $^1/_4$-in. thick ordinary glass when dropped 9 in., a drop of 156 in. was necessary to break "Armourplate" glass having the same thickness and support. The fractured edges of this new glass are not sharp and can be handled without fear of cuts. A piece of "Armourplate" on supports 40 in. apart will bend 2.88 in. in the center before breaking, compared to 0.52 in. for ordinary plate glass. In the static twisting test on 40-in. pieces one end of the ordinary glass could be twisted through an angle of 9.25° with respect to the other end, while in the case of "Armourplate" the angle was 28.6°. Transverse strength is about four times that of ordinary plate glass. Resistance to heat shock is also much better. "Armourplate" chips a little easier on the edges than does ordinary plate glass. The manufacturer says that "Armourplate" is a natural glass that has been subjected to special heat treatment. The glass is sold cut to order in sizes up to 70 x 50 in. according to thickness. Pilkington Brothers do not accept responsibility for breakage where a customer tries to cut or "work" the glass after receipt from the works. W.W.M.

Methods of safety glass manufacture. FRITZ OHL. *Sprechsaal*, **66** [2], 20–22 (1933).—Substitutes for nitrocellulose as the intermediate layer of safety glass are discussed. The properties of the safety glasses produced with some of these, such as cellulose acetate, cellulose benzoate, and some of the synthetic resins, are described. See also *Ceram. Abs.*, **12** [3], 100 (1933). W.W.B.

Manufacturing processes for safety glass. HELMUT MERTENS. *Sprechsaal*, **66** [2], 19–20 (1933).—A brief review of the processes involved in the manufacture of safety glass is given. The types of safety glass considered are (1) laminated glass, (2) "Hartglas," a suddenly chilled glass which crumbles instead of splintering on being broken, and (3) glass substitutes. See also *Ceram. Abs.*, **11** [10], 522 (1932). W.W.B.

Manufacture of safety glass. ANON. *Ind. chimique*, **20** [228], 66 (1933). M.V.K.

Claim 50% melting time reduction with glass tank design. SURFACE COMBUSTION CORP. *Ceram. Ind.*, **20** [2], 64–65 (1933).—Diffusion combustion applied to glassmelting through the medium of a continuous tank of entirely new and different design is being tested by the Surface Combustion Co., Toledo, Ohio, in a commercial installation. Complete control of temperature conditions is made possible. The accomplishments and operation of the new tank are given, together with a drawing showing the operating principles. Local overheating is prevented and the furnace atmosphere is controlled. Diffusion combustion speeds the melting process because of the greater area used in the heat transfer. W.W.M.

Using oxygen in glassmelting. S. S. BERMAN. *Keram. i Steklo*, **8** [11], 31–34 (1932).—The possibilities and expediency of utilizing air enriched with oxygen for firing glassmelting furnaces are discussed. M.V.K.

What causes glass tank failures? I. C. S. LINDER. *Ceram. Ind.*, **20** [2], 91 (1933).—L. gives some of the causes for glass tank failures and makes suggestions which will increase tank block service. Stones in glass are discussed. **II.** *Ibid.*, **20** [3], 149–51 (1933).—Bad design is one cause of glass tank failures. Factors of design are outlined. Accidents to air and water lines for cooling sometimes cause tank block failures. Other causes which reduce the life of glass tanks include too high temperatures, forcing heating schedule, operating over capacity, excessively corrosive batch, and shallow tanks which corrode more readily in the bottom. Dirty cullet and tramp iron also corrode the tank bottom. W.W.M.

Methods of oil heating in glass furnaces and their advantages and drawbacks. P. G. GRIGOR'EV. *Keram. i Steklo*, **8** [12], 12–16 (1932).—The following methods are used in burning oil fuel in the glass industry: (1) burning oil fuel with the help of special dropping devices (spontaneous flow); (2) pulverizing with steam or air (the fuel flowing through sprayers is pulverized and fed to the furnace); and (3) mechanical pulverization when the oil is atomized under pressure and enters the furnace in a state of suspension. G. concludes that the most economical method of burning oil fuel is by mechanical sprayers. For auxiliary furnaces (annealing furnaces) air sprayers of low pressure are best. M.V.K.

Modern machinery for mold making for the glass industry. F. S. HARMER. *Pottery Glass Rec.* [Eng.], **14** [12], 358–59 (1932).—The production of ordinary bottle shapes, the milling of mold faces, and the engraving of molds are described. "Ardoloy," a new tungsten carbide alloy, plays an important part in boring molds. Higher cutting speeds and finer feeds are possible with consequent improvement in finish. See also *Ceram. Abs.*, **12** [2], 70 (1933). M.V.K.

Design and form as applied to manufacture of glassware. JAMES H. HOGAN. *Pottery Gaz.*, **58** [669], 343–47 (1933).—The peculiar qualities of glass are ductility when heated and transparency when cold. The three processes used in the manufacture of glassware, hand blowing, mold blowing, and pressing, are briefly discussed. H. discusses over-ornamentation, cutting and engraving, best types of cutting, over-predominant cuttings, etching and engraving, simplicity in decoration, and well-designed mass production ware. E.J.V.

Glass as a structural and stress-resisting material. F. W. PRESTON. *Jour. Amer. Ceram. Soc.*, **16** [4], 163–86 (1933).

Building of glass a reality. OWENS-ILLINOIS GLASS CO. *Ceram. Ind.*, **20** [3], 140–44 (1933).—Research work of the Owens-Illinois Glass Co. has resulted in the development of a practical building unit. The unit and its method of use are described. Color effects and architectural possibilities are discussed. Comparative data on its heat transmission compared with other building materials are presented. Properties of light transmission and thermal expansion are also given. See also *Ceram. Abs.*, **12** [2], 58 (1933). W.W.M.

Innovations from the state technical school for the glass industry at Steinschoenau. HARALD ULLMANN. *Sprechsaal*, **65** [42], 761–62 (1932).—An automatic sandblasting machine, a machine for blowing holes through glass, a high-velocity cutting machine, and a laboratory glassmelting furnace are described. W.W.B.

Colored glasses for automobile headlights. C. MÜNSTER. *Z. tech. Physik*, **14** [2], 73–78 (1933).—Investigations were made to find out which color will penetrate fog better than the ordinary white light. A special set-up has been developed including a searchlight, refractor, and photometer. In a distance of 50 yards, a yellow glass will increase the contrast from 10 to 20%, a red one from 20 to 30%. W.M.C.

Electrical glassmelting in U.S.S.R. M. A. BESBORODOV. *Keram. i Steklo*, **8** [11], 29–31 (1932).—B. points out the imperfections of present methods of glassmelting from the economical and physico-chemical points of view. The results of the attempts of Cornelius (England) to use electrical furnaces for melting glass are described. M.V.K.

Progress in mechanizing the glass industry in U.S.S.R. and problems involved. I. S. SHUR. *Keram. i Steklo*, **8** [11], 17–19 (1932).—The present state of the Russian glass industry and its future expansion are discussed. M.V.K.

Scientific research work on glass of the State Optical Institute of Russia. K. A. KRAKAU AND N. A. SHALBEROV. *Keram. i Steklo*, **8** [11], 24–28 (1932).—A survey of the work carried on by the State Optical Institute in Russia in regard to glass and its properties is given. M.V.K.

Table glass by mass production. ANON. *Pottery Gas.*, **58** [669], 341–42 (1933).—A brief description of the machine production of table glassware at the Sherdley glass works, a subsidiary of the United Glass Bottle Mfrs., Ltd., at St. Helens, is given. Illustrated. E.J.V.

Present-day glass in old-time forms. CARL GREENLEAF BEEDE. *Christian Sci. Mon.*, **25** [26], 8 (1932).—Among the glassware seen recently in several shop displays, there has been noticed an unusual number of forms copied from those common in America a hundred or more years ago. The accuracy of these reproductions, in design details and in color, is so close that they might easily pass as of an age equal to their types. A brief description of some of the varied types of objects and the glass used in their production is given. Illustrated. E.J.V.

Pressed glass exhibited. M. R. Z. *Christian Sci. Mon.*, **25** [31], 8 (1932).—Some of the pieces of American pressed glass from a collection of over 300 pieces placed on exhibit by Mrs. Justus L. Johnson, Aurora, Ill., at the Chicago Art Institute, are briefly described. E.J.V.

Old Theresienthal glasses. B. MAUDER. *Sprechsaal*, **66** [1], 5–7 (1933).—The art glasses produced at Theresienthal about 1880 are discussed, and numbers of individual pieces are illustrated and described in detail. The work done at Theresienthal was original and not an attempt at copying the art of the Venetians. W.W.B.

Old English glasses. No. 39. Scent bottles. F. BUCKLEY. *Glass*, **10** [2], 57–58 (1933).—A variety of scent bottles is described and illustrated, some dating from the 17th Century. For No. 38 see *Ceram. Abs.*, **12** [4], 149 (1933). G.R.S.

Origin of the erroneous view that there were ancient Egyptian glassblowers. MAX SPETER. *Glastech. Ber.*, **10** [12], 647–49 (1932).—Evidence is adduced to prove that the supposed glassblowers in a number of ancient Egyptian drawings and carvings are in reality laborers supplying a draft to a smelting furnace by means of blowpipes. What were thought to be lumps of glass at the ends of the blowpipes are merely lumps of clay to protect the blowpipe from the fire. The mistaken idea that they represent glassblowers is due largely to faulty sketches that were made from the original Egyptian drawings that were widely circulated. W.W.B.

Egyptian glass. L. M. ANGUS-BUTTERWORTH. *Glass Ind.*, **14** [2], 21–24 (1933).—Glass was not actually manufactured in Egypt before about 1500 B.C. All the early glass discovered in Egypt is colored, never transparent, as it was made up in the form of glass paste to imitate gems, etc. Probably the most remarkable use the Egyptians made of glass was in connection with figure subjects. About 1200 B.C. they began to press glass in molds. Glass weights were molded from 350 A.D. onward for use as standard weights for gold coins. Some of the other articles and the colored glasses made by the Egyptians are described. E.J.V.

BOOK

Glass Factory Year Book and Directory, 1932 Edition. American Glass Review, Pittsburgh. 152 pp. Price $3.00. *Mech. Eng.*, **54** [9], 665 (1932).—This is a well-arranged directory of the manufacturers of glass, with information as to officers, equipment, and products. The directory also lists them by products and includes lists of trade associations and workers' unions, statistics of the industry, and miscellaneous technical data. F.G.H.

PATENTS

Charge-severing mechanism. R. G. ALLEN (Owens-Illinois Glass Co.). U. S. 1,897,993, Feb. 21, 1933.

Glass grinding machine. H. K. HITCHCOCK (Pittsburgh Plate Glass Co.). U. S. 1,898,012, Feb. 21, 1933.

Process for producing homogeneous glass in tanks. FRITZ ECKERT. U. S. 1,898,039, Feb. 21, 1933.

Pneumatic glass feeder. THOMAS STENHOUSE (Hazel-Atlas Glass Co.). U. S. 1,898,101, Feb. 21, 1933.

Sheet glass manufacture. W. L. VAN NESS. U. S. 1,898,157, Feb. 21, 1933.

Glassblowing machine. L. D. SOUBIER (Owens-Illinois Glass Co.). U. S. 1,898,222, Feb. 21, 1933.

Mold for making pressed-glass articles. NICHOLAS KOPP. U. S. 1,898,251, Feb. 21, 1933.

Glass gathering tank. E. G. BRIDGES (Lynch Corp.). U. S. 1,898,289, Feb. 21, 1933.

Machine for forming hollow glassware. L. D. SOUBIER (Owens-Illinois Glass Co.).

U. S. 1,898,404, Feb. 21, 1933. J. H. TREECE AND J. E. MCLAUGHLIN (Owens-Illinois Glass Co.). U. S. 1,898,408, Feb. 21, 1933.

Shear mechanism for glassware forming machines. J. H. TREECE (Owens-Illinois Glass Co.). U. S. 1,898,407, Feb. 21, 1933.

Apparatus for feeding molten glass. E. P. WOOD AND W. C. OSTERBROCK. U. S. 1,898,705, Feb. 21, 1933.

Method of applying decoration to glass and the resulting product. E. D. REINHOLD. U. S. 1,898,745, Feb. 21, 1933.

Method of making glass bar. JAMES GROSS. U. S. 1,899,146, Feb. 28, 1933.

Method of making glass mix for opaque containers. C. W. CROWELL. U. S. 1,899,230, Feb. 28, 1933.

Glass coffee pot. H. C. BATES (Corning Glass Works). U. S. 1,899,451, Feb. 28, 1933.

Method and means for treating glass articles. R. D. SMITH (Corning Glass Works). U. S. 1,899,485, Feb. 28, 1933.

Laminated glass. H. C. ROHLFS (General Electric Co.). U. S. 1,899,588, Feb. 28, 1933. J. C. ZOLA (Duplate Corp.). U. S. 1,900,536, March 7, 1933.

Process of producing composite sheets of safety glass. C. H. H. LAMBERTY (E. B. C. Woodbury). U. S. 1,899,621, Feb. 28, 1933.

Glass treatment. F. G. SCHWALBE. U. S. 1,899,640, Feb. 28, 1933.

Method and apparatus for coating the interior wall of hollow bodies. A. M. HAGEMAN AND A. F. LINDSTROM (Westinghouse Lamp Co.). U. S. 1,900,104, March 7, 1933.

Forehearth for molten glass. VERGIL MULHOLLAND AND A. R. HUNTER (Hartford-Empire Co.). U. S. 1,900,361, March 7, 1933. VERGIL MULHOLLAND (Hartford-Empire Co.). U. S. 1,900,362, March 7, 1933.

Glassmelting apparatus. E. G. DE CORIOLIS AND P. Q. WILLIAMS (Surface Combustion Corp.). U. S. 1,900,432, March 7, 1933.

Bulb and method of coloring. MARVIN PIPKIN (General Electric Co.). U. S. 1,900,463, March 7, 1933.

Process of cooling roll for molten glass. H. K. HITCHCOCK (Pittsburgh Plate Glass Co.). U. S. 1,900,556, March 7, 1933.

Apparatus for case hardening glass sheets. WILLIAM OWEN (Pittsburgh Plate Glass Co.). U. S. 1,900,582 and 1,900,583, March 7, 1933.

Wire glass manufacture. G. H. JUERGENS (Mississippi Glass Co.). U. S. 1,900,716, March 7, 1933.

Manufacture of glassware. THOMAS WARDLEY. U. S. 1,900,781, March 7, 1933. Apparatus for use in transferring glassware is described.

Automatic glass-feeding machines. GREGG & CO. (Knottingley), LTD., AND H. GREGG. Brit. 387,082, Feb. 8, 1933.

Glass bulbs for incandescent electric lamps. L. F. DE BACKER. Brit. 387,152, Feb. 8, 1933.

Lining surfaces such as walls and floors with glass plates. K. MORITA. Brit. 387,211, Feb. 8, 1933.

Process and apparatus for breaking off lengths of wired glass. PILKINGTON BROS., LTD., AND H. SMITH. Brit. 387,392, Feb. 15, 1933.

Safety glass. I. G. FARBENIND. A.-G. Fr. 40,116, April 17, 1931. Safety glass is made of a layer of transparent polymerized products of vinyl compounds other than simple polyvinyl esters between 2 or more layers of glass. See also *Ceram. Abs.*, **10** [8], 564 (1931). (*C.A.*)

Apparatus for rolling sheets of glass. COMPAGNIES RÉUNIES DES GLACES ET VERRES SPÉCIAUX DU NORD DE LA FRANCE. Fr. 731,177, Feb. 8, 1932. (*C.A.*)

Safety glass. IGNACIO S. VIDAL. Fr. 731,644, Feb. 22, 1932. Sheets of transparent material such as celluloid are applied to one of the faces of two sheets of glass and the two sheets of celluloid, etc., are joined by a transparent substance which may be liquid, viscous, or solid at ordinary temperature. (*C.A.*)

Apparatus for making sheets of glass. FORGES ET ATELIERS DE CONSTRUCTIONS ÉLECTRIQUES DE JEUMONT. Fr. 731,950, April 22, 1931. (*C.A.*)

Safety glass. RÖHM & HAAS A.-G. Fr. 732,051, Jan. 29, 1932. Gases and air bubbles are eliminated from the solution of the compound to form the transparent film by a gradual heating, during which time evaporation of the solvent is preferably prevented. The solution is then poured on the sheets of glass and the solvent removed by a slow evaporation. (*C.A.*)

Glassmaking furnaces. ÉTIENNE FECHOZ. Fr. 732,179, Feb. 23, 1932. (*C.A.*)

Apparatus for making reinforced glass in continuous sheets. SOC. ANON. DES MANUFACTURES DES GLACES ET PRODUITS CHIMIQUES DE SAINT-GOBAIN, CHAUNY, ET CIREY. Fr. 733,442, June 8, 1931. (*C.A.*)

Tank furnace for melting glass. JENAER GLASWERK SCHOTT & GEN. Ger. 558,256, March 2, 1930. (*C.A.*)

Apparatus for making glass tubes or rods. GEORGES MONPEURT AND ALBERT GLARDON. Ger. 558,321, March 26, 1931. (*C.A.*)

Suction device for withdrawing molten glass from a container. HEINZ NACHOD (Patent-Treuhand-Ges. für elek. Glühlampen m. b. H.). Ger. 559,098, April 25, 1931. (*C.A.*)

Method of fusing tungsten articles into glass. W. D. VAN WIJK AND J. A. M. VAN LIEMPT (N.-V. Philips' Gloeilampenfabrieken). Ger. 562,203, Nov. 8, 1930. (*C.A.*)

Continuous apparatus for drawing glass tubes or rods. PANCRAS SCHOONENBERG (N.-V. Philips' Gloeilampenfabrieken). Ger. 562,222, Aug. 26, 1926. (*C.A.*)

Hardening optical glass. EMIL BUSCH A.-G. OPTISCHE INDUSTRIE. Ger. 562,330, Nov. 26, 1930. Lenses, etc., are heated for a long time at a temperature below the transformation point of the glass and then suddenly cooled. The two sides of the lenses, etc., may be heated to different temperatures. (*C.A.*)

Structural Clay Products

Use of sucrose in sand-lime brick. W. A. HAMOR, GERALD J. COX, JOHN METSCHL, AND J. W. VAN BRUNT. *Jour. Amer. Ceram. Soc.*, **16** [4], 187–91 (1933).

Processes employed in producing colors in common brick. H. G. LUTTER. *Brick Clay Rec.*, **82** [1], 19 (1933).—One of the simplest and cheapest methods of coloring brick is the use of metals in flashing. Slips of colored clays may be applied or metals can be introduced into a slip made of the same material as the body. The nature of the clay, method of firing, and extent of oxidizing or reducing conditions enter into the final results. E.J.V.

Manufacture of lightweight brick. ANON. *Brit. Clayworker*, **41** [490], 353–54 (1933).—The most usual method of making a porous lightweight brick, other than the diatomaceous type, is by the addition of an organic substance such as sawdust which burns out during firing of the ware. Another method is by mixing the clay with foam which can be made of a sufficiently tenacious character by beating or blowing air into a mixture of water with soap bark, glue, liquorice, etc. The most recent development is to make porous ware with an impervious skin. The material used for this purpose may be a shale or clay which vitrifies at about 1200°C. This is granulated, mixed with a suitable proportion of low-grade powdered coal or colliery waste, and then given necessary firing treatments. R.A.H.

Porous brick. ANON. *Tonind.-Ztg.*, **57** [10], 116–17 (1933).—Porous brick show a small unit weight and good insulating properties. The interval between the firing temperature and the melting point of the clay should be as large as possible if foreign substances are added, *e.g.*, coal, sawdust, etc. A large number of small pores is better than a small number of large pores. A table is given showing shrinkage, unit weight, strength, and heat conductivity of a clay with additions of 10 to 45% coal and 20 to 40% sawdust. The properties of some of these mixtures are better than those of large-sized tile. Proposals for increasing the porosity by chemical means are discussed, such as preparing a foamy body or adding aluminum and a small amount of alkali. Such processes, however, are not being used yet on a commercial basis. W.M.C.

Applying the de-airing process to the manufacture of paving brick. R. B. KEPLINGER. *Brick Clay Rec.*, **82** [2], 55–56 (1933).—As a result of installing a large-size vacuum brick machine, striking improvement was noted in the green ware, the crushing strength was increased, and laminations were reduced but some difficulties were encountered in the drying and firing. E.J.V.

Some problems solved in the production of vertical fiber paving brick. H. C. KENYON. *Brick Clay Rec.*, **82** [1], 17–18 (1933).—Because of a high rattler loss on repressed pavers, it was noted that the greatest loss was made on the die surfaces. Investigation showed this to be due mainly to auger lamination and the addition of sandstone to the mix cured that difficulty. Another aid in decreasing loss was the rearrangement of the required lugs. Illustrated. E.J.V.

Use of brick for apartment houses. F. HERBST. *Tonind.-Ztg.*, **56** [101], 1239–

40; [103], 1264–65 (1932).—Attention should be given to the development of large-sized tile with regard to the several advantages over standard-sized common brick. W.M.C.

Brick buildings. THEIN. *Tonind.-Ztg.*, **57** [2], 11–14; [4], 36–38 (1933). W.M.C.

Large-sized hollow tile and their use. E. KÜHL. *Tonind.-Ztg.*, **57** [3], 25–26 (1933). W.M.C.

Asphalt-impregnated tile. ANON. *Chem. Met. Eng.*, **40** [2], 81 (1933).—In order to facilitate placement the impregnated tile is produced in sections for lining sewers and disposal tanks, metal pickling tanks, drainage pipes, and irrigation ditches. Tile which is not too dense to prevent thorough impregnation of the asphalt is selected. The tile is placed in a retort and the air is exhausted. The temperature is slowly raised to 250°F, and hot asphalt is forced in under pressure. G.R.S.

Providing a more efficient joint for vitrified clay pipe. ANON. *Brick Clay Rec.*, **82** [2], 60–61 (1933).—Asphaltic rings are being precast in the bell and on the spigot of sewer pipe as an improvement in the joint obtainable in laying of sewer lines. Illustrated. E.J.V.

Year's developments in reinforced brick masonry. HUGO FILIPPI. *Clay-Worker*, **99** [2], 55–57 (1933).—A detailed report of the progress made in the actual application and use of reinforced brick masonry and tests made at various scientific institutions is presented. E.J.V.

Fabricated homes demand new clay products from industry. O. W. RENKERT. *Brick Clay Rec.*, **82** [1], 21 (1933).—Lightweight units and precast slabs are suggested as possible answers to the problem. See also abstract by Bole, *Ceram. Abs.*, **12** [4], 154 (1933). E.J.V.

Steel should improve existing methods of home building. LEE H. MILLER. *Brick Clay Rec.*, **82** [2], 58–59 (1933); *Clay-Worker*, **99** [2], 57 (1933).—M. points out that rather than promoting new types of construction, existing practices of proven value should be made better with steel, such as building steel frame clay-products houses. Illustrated. E.J.V.

Beauty of old world architecture produced by clay products. ANON. *Brick Clay Rec.*, **82** [2], 66–68 (1933).—The Northeastern Federal Penitentiary at Lewisburg, Pa., is built in pure Lombard Romanesque design, both exterior and interior. A total of 3,000,000 standard face brick, 582,000 special shapes of 574 different units, and 375 tons of architectural terra cotta was used in the construction. The effect of action of time was reproduced by hand on the clay units and the structure has the appearance of being exposed to the elements for 5 centuries. Illustrated. E.J.V.

What we did about the depression. H. C. KLEYMEYER. *Brick Clay Rec.*, **82** [1], 11–12 (1933).—The Standard Brick Mfg. Corp., Evansville, Ind., improved its business by increasing its lines of clay products from brick to include backup building tile and floor, partition, and furring tile, as well as drain tile, using the same machine with interchangeable dies. Improvements have also been made in the pugging and down-draft kilns. E.J.V.

Standard specifications for brick in Czechoslovakia. ANON. *Tonind.-Ztg.*, **56** [99], 1218–20 (1932).—This is a complete translation of the standard specifications recently adopted in Czechoslovakia. W.M.C.

BOOKS

Clinkers for Technical Applications, Their Production and Use. (Die Klinker für technische Verwendungszwecke, ihre Herstellung und Verwendung.) FELIX NIEBLING. 45 pp. Verlag Wilhelm Knapp, Halle a. S., Germany. Price, paper 3.75 Rm., cloth 4.30 Rm. *Ber. deut. keram. Ges.*, **13** [10], 466 (1932).—The fields of ceramics in which clinkers can be used include production of lightweight brick, acid-resistant materials, flooring materials, etc. Applications, production, and use of clinker are described. E.J.V.

Production of Porous Brick. (Die Herstellung poröser Ziegel.) V. PINKL. Verlag Wilhelm Knapp, Halle a. S., Germany. 40 pp. Price 3 Rm. *Ber. deut. keram. Ges.*, **13** [10], 466 (1932). E.J.V.

PATENTS

Sectional block clay tile. F. H. MEIER. U. S. 1,898,380, Feb. 21, 1933.

Brick holder. R. A. WEIS (Stark Brick Co.). U. S. 1,899,125, Feb. 28, 1933.

Brick-hacking apparatus. F. C. LAYER. U. S. 1,900,243, March 7, 1933

Refractories

Determination of corrosion on vessels of pure oxides. R. WINZER. *Angew. Chem.*, **45** [26], 429–31 (1932).—The corrosive resistance of vessels made of Al_2O_3, ZrO_2, BeO, MgO, ThO_2, and mixtures of these oxides was studied. The vessels had been fired at temperatures of 1800 to 2000°C. They had a hard porcelain-like texture and were quite dense up to high temperatures. The vessels were unattacked by all gases and vapors (except fluorine) at temperatures of 1700 to 1800°. In the presence of carbon or CO the vessels were generally attacked by the halogens. The corrosive action of hot acids and bases, molten metals and salts, and of oxides and hydroxides was studied. The results of the tests are given in detailed tables. In general, molten minerals and salts do not attack the crucibles below 1200° largely because of their great density. Above 1200°C the crucibles showed great resistance to silicates. Alkali silicates, borates, and phosphates had hardly any effect on alumina crucibles. Even technical glasses took up little Al_2O_3. No close relation was evident between the degree of corrosion and the acidic or basic properties of the melt. Vessels which had been kept porous by firing at low temperatures prior to testing were attacked much more than high-fired, dense crucibles. L.T.B.

Materials with the highest melting point and their utilization. CURT AGTE. *Feuerfest*, **9** [1], 1–4 (1933).—Binary compounds of the highest melting metals of the 4, 5, and 6 groups of the periodic system when combined with carbon, nitrogen, and boron possess melting points which in some cases exceed the melting point of metals having the highest melting temperature. They are produced by (1) heating the metal or oxide with carbon until the formation of carbide, (2) heating the metal in a nitrogen current until the nitride is obtained, and (3) calcining the metal with boron in required mixing proportion. An especially high melting point is shown by tantalum carbide and hafnium carbide, and even higher melting points are obtained with mixtures consisting of tantalum carbide and zirconium carbide or hafnium carbide (the highest melting point ever ascertained for solid bodies). The compounds show an electrical conductivity similar to that of metals, sometimes a "super-conductivity." Their hardness lies between 8 and 10 of Mohs' scale. Chemically they are indifferent. These materials may be utilized as radiators, furnace material, abrasives, and as hard components for hard metals. See also *Ceram. Abs.*, **11** [8], 457 (1932). M.V.K.

Chemistry of high temperatures. OTTO RUFF. *Angew. Chem.*, **46** [1], 1–7 (1933).—R. reviews the behavior of materials at high temperatures. Reactions at high temperatures are not any different in principle from reactions at low temperatures. The article includes a résumé of the properties of some of the refractory oxides, means for measuring temperatures, vapor and dissociation pressures, and sintering and volatility of materials. L.T.B.

Obtaining silica gel from silicon tetrachloride, a residue in the production of aluminium chloride from kaolin. B. P. BRUNS AND E. G. CHATUNOVSKAYA. *Zhur. Khim. Prom.*, **7** [7], 34–36 (1932); abstracted in *Chim. & ind.*, **29** [2], 364 (1933).—The gaseous silicon tetrachloride liberated during the manufacture of aluminium chloride from kaolin may be used for obtaining silica gel by the simple action of water according to the following equation: $SiCl_4 + nH_2O \longrightarrow SiO_2{\cdot}nH_2O + 4HCl$. M.V.K.

Aluminium chloride from bauxite and clay. ANON. *Novosti Techniki*, No. 169, p. 5; abstracted in *Chem. Trade Jour.*, **92** [2386], 109 (1933).—The process is one of continuous chlorination, and once it has been started by raising the initial temperature to 900°, no further external heating is required as the reaction is exothermic. The process is effected in simple shaft furnaces on the counter-current principle. The furnaces are first heated to a dull red by the combustion of generator gas. The heating is discontinued and the reaction gases (equimolecular mixture of chlorine and carbon monoxide) are introduced cold. After a short time a sharp increase in temperature is noted, but the process is so regulated by the introduction of fresh raw material and the removal of treated products that the temperature is maintained constant at about 900°. In the case of china clay, the reaction takes place at 1000 to 1050° when the loss in chloride due to the formation of silicon chloride is reduced to a minimum. M.V.K.

Aluminium oxide as high refractory material. H. GERDIEN. *Z. tech. Physik*, **13** [12], 586–90 (1932); abstracted in *Feuerfest*, **9** [1], 13 (1933).—G. discusses (1) present technique with regard to highly refractory materials, (2) sintered corundum and its physical, mechanical, thermal, and electrical properties, (3) usability, (4) possibilities in changing the methods of production, (5) chemical behavior, and (6) fields of application. M.V.K.

Refractory material. ANON. *Chim. & ind.*, **29** [2], 481 (1933).—A new refractory

material is composed of 20 to 40% chromium oxide, 18 to 30% magnesia, 25 to 45% alumina, and 8 to 14% of other constituents. This material is produced from slag in the manufacture of ferrochrome. To obtain the material directly from the melted slag, special molds are used. The molded brick is somewhat larger than normal brick. The refractoriness of this material is over Seger cone 42 and its thermal stability under pressure exceeds 1810°. Its resistance to the attack of slag is high. M.V.K.

Characteristics of some special refractory products. II. MARCEL LÉPINGLE. *Rev. mat. constr. trav. pub.*, No. 280, pp. 6–8*B* (1933).—L. briefly reviews the manufacture of English and German special refractory products together with their chemical analyses and characteristics. For Part I see *Ceram. Abs.*, **12** [4], 157 (1933). M.V.K.

Refractory paint. LACLEDE-CHRISTY CLAY PRODUCTS CO. *Foundry*, **61** [1], 32 (1933).—A high-temperature paint is presented which is an odorless, heat-resisting, protective coating material. The most refractory type of this new line is the black paint which will withstand 1800°F. Red, green, gray, and white paints will withstand temperatures ranging from 1000 to 1400°F. F.G.H.

Refractory coating masses. GALLUS. *Wärme*, **55** [44], 756–57 (1932); abstracted in *Feuerfest*, **9** [1], 13 (1933).—G. discusses (1) the purpose of refractory linings, (2) chief requirements for the masses to be used, (3) methods of application, (4) mixes hardening immediately and on firing, (5) simple tests for their suitability, (6) preparing masonry for the linings, and (7) composition of masses on the market. M.V.K.

Significance of refractory materials to the metallurgical industries. A. T. GREEN. *Jour. Inst. Metals*, **53** [1], vi (1933).—G. discusses the subject under the following headings: (1) the more important properties, including refractoriness, refractoriness under load, thermal expansion, and thermal properties; (2) factors influencing the durability of refractory materials; and (3) particular applications in the metallurgical industries. F.G.H.

Refractory materials and the nonferrous industries. A. B. SEARLE. *Jour. Inst. Metals*, **50** [11], cxlix (1932); for abstract see *Ceram. Abs.*, **12** [2], 65 (1933). F.G.H.

Constitution of raw bauxite ore from the deposits at Bodayk (Hungary). HORST RUMPELT. *Metall Erz*, **29**, 471–74 (1932).—X-ray examination shows that bauxite from Bodayk contains Fe_2O_3 as goethite, Al_2O_3 as bauxite, and SiO_2 chiefly as quartz. The goethite appears to be present in two different degrees of dispersion, the more highly dispersed form being found in the bauxite concentrate. See also *Ceram. Abs.*, **11** [11], 574 (1932). (*C.A.*)

Shrinkage of magnesite-containing bodies. H. NITZSCHE. *Tonind.-Ztg.*, **57** [11], 127–29 (1933).—The shrinkage of 5 magnesite samples was determined. Graphs and tables show the results for the original samples and several mixtures. No simple law was found which can be applied to the shrinkage behavior observed. W.M.C.

Hydration of dead-burned magnesite. W. EITEL. *Angew. Chem.*, **46** [3], 69 (1933).—Technical working of dead-burned magnesite requires a definite treatment of the material, Mauken, during which $Mg(OH)_2$ forms. For the formation of the hydrate certain optimum conditions must be taken into account. Too small a content of the hydrate results in a product which is not plastic enough for working and too high a content results in firing failures later on. The hydration of magnesite depends on particle size, firing temperature, composition, and storage. The factors relating to hydrate formation and expansion during hydration were studied. If a minimum expansion is exceeded typical cracking of the material takes place. L.T.B.

Magnesite in South Africa. A. W. CARRUTHERS. *Official Yearbook of S. Africa*, **13**, 470 (1932).—Magnesite deposits occurring as stockwork of veins in serpentine are extensive in the Transvaal, notably at Kaapmuiden. CO_2 is used in Johannesburg, and the residue is turned into cupels. H.H.S.

Russian magnesite industry. A. LULKI. *Tonind.-Ztg.*, **57** [8], 87–88 (1933).—The export of magnesite brick, powdered magnesite, and caustic magnesite has been increased considerably since 1926, though the amount of magnesite used in the Russian domestic market has increased at the same time. The erection of several new plants is being planned within the second five-year plan. W.M.C.

Chromite-Dinas brick. P. P. BUDNIKOFF AND E. L. MANDELGRÜN. *Ber. deut. keram. Ges.*, **13** [11], 521–24 (1932); for abstract see *Ceram. Abs.*, **12** [3], 110 (1933). E.J.V.

Silicon-carbide brick. ANON. *Tonind.-Ztg.*, **56** [101], 1242–43 (1932). W.M.C.

Refractories for industrial furnaces. V. F. H. NORTON. *Fuels & Fur.*, **11** [1], 13–22 (1933).—Among the most modern developments in refractories is the production of a good refractory insulator at a reasonable cost. N. outlines the desired properties in a refractory insulator, processes used in making it, methods of determining the

thermal conductivity at high temperatures, and properties of some typical commercial refractory insulators and makes a comparison of insulating refractories and fire brick. The method of using insulating refractories in furnace construction and some actual installations thereof are discussed. Illustrated. For Part IV see *Ceram. Abs.*, **12** [2], 67 (1933). E.J.V.

Using plastic refractory materials in the construction of fireplaces of furnaces and boilers. J. AUBÉ. *Chaleur et ind.*, **13,** 150 (1932); Supp.: Courrier Établissement Jean Aubé, pp. 1–4; abstracted in *Feuerfest*, **9** [1], 14 (1933).—The advantages, methods of application, and possibilities of using the plastic refractory "Monolite" for jointless, elastic, and absolutely dense linings in fireplaces are described. M.V.K.

Lining cement kilns for manufacturing high-quality cements. ANON. *Tonind.-Ztg.*, **57** [7], 75–76 (1933).—High-temperature as well as low-temperature clinkers require an expensive furnace lining of high refractoriness, good mechanical resistance, and low porosity. No satisfactory lining is available yet for clinkers obtained by the addition of fluxes to ordinary raw materials. W.M.C.

Cement for furnace settings. ANON. *Metallurgia*, **7** [40], 20*A* (1933).—"Sairset" has a high alumina content and uses, as a base, diaspore which is an extremely hard monohydrate of alumina having a fusion temperature above 3440 to 3550°F and a specific gravity of 3.4. Sairset cement is applied after mixing with water, and setting takes place at room temperature. The fusion point of the cement is higher than ordinary cements made from flint fire clays. It has practically the same physical and chemical properties as the best fire brick, is almost neutral to expansion and contraction, and is resistant to temperatures as high as 3000°F. When employed for bonding, the cement after firing has a transverse breaking strength of over 1000 lb./sq. in., forming an efficient dense hard joint which offers strong resistance to the destructive effects of slagging. M.V.K.

Use of Siemensit in kilns. A. SPRENGER. *Tonind.-Ztg.*, **57** [2], 14–15; [4], 39–40 (1933); see also *Ceram. Abs.*, **12** [3], 108 (1933). W.M.C.

Hearth breakdown in blast furnace No. 1 at the Mariupol plant in 1931. N. V. KLISHEVICH. *Domez*, No. 6, pp. 25–29 (1932).—Details of the furnace and of the causes which led to the breakdown of the hearth are described. The gradual destruction of the furnace lining at the point where the molten metal broke through the wall is illustrated in a series of drawings. (*C.A.*)

Present-day effects of salt in coal. C. CAMPBELL. *Colliery Guard.*, **145** [3757], 1247–48 (1932).—Firebrick linings begin to disintegrate as the result of alkali volatilized to the surface and into the brickwork pores. In reverberatory furnaces the combination of direct impingement of the flame on the roof and the action of volatilized salt causes considerable damage. In the various forms of basic hearths "salty" coals appear to have no reaction whatever, but acid hearths are more detrimentally affected than are those of fire brick. The effect of "salty" coals on the refractory linings of coke ovens shows that the disintegrating action is most severe at high temperatures, particularly where the coal is wet. E.J.V.

Insulated covered ladles. D. O. THOMAS. *Foundry*, **61** [1], 18 (1933).—Most ladles now used for handling molten iron consist of a steel shell with a suitable refractory lining. Invariably these ladles have relatively thin walls and are open completely at the top, conditions favoring the rapid cooling of the molten iron. To reduce this cooling of the iron and to facilitate handling of the metal, insulated and covered ladles have been developed. Details for the insulating and refractory lining of such ladles are described and illustrated. The average life of the new type pouring ladle is 23 actual pouring days as compared with a 4-day life of the old type. Although the relining cost of the new type ladle is three times that of the old ladle, the actual cost per day of service for the new type ladle is only half that of the old ladle due to the longer life. Due to oxidation and slag action, a more resistant refractory is required for the ladle covers than for the side walls and bottom. F.G.H.

Refractory plugs and spouts for ingot molds in iron metallurgy. P. P. BUDNIKOFF AND S. P. LOGINOV. *Domez*, No. 6, pp. 30–35 (1932).—Plugs and spouts were prepared from the following mixtures: (1) 25% refractory plastic clay containing 38 to 40% Al_2O_3, 25% chamotte containing 38 to 39% Al_2O_3 and 50% Ceylon graphite (all these were crushed to a grain below 1 mm. size); (2) 35% refractory plastic clay containing 38 to 39.5% Al_2O_3, size of grain below 1 mm., and 65% chamotte, size below 0.5 mm. The plugs and spouts produced from these mixtures were tested for refractoriness, porosity, H_2O absorptiveness, specific gravity, and shrinkage on firing. A table is given showing these properties and the mineral and chemical composition of the various samples prepared. (*C.A.*)

Refractories in 1932. ANON. *Blast Fur. Steel Plant*, **21** [1], 70–71 (1933). E.J.V.

BOOK AND BULLETINS

Federal specification HH-B-671a for fireclay brick. ANON. Supt. of Documents, Govt. Printing Office, Washington, D. C. 5¢. This specification is a revision of HH-B-671 for fireclay brick. It becomes mandatory for all department and independent establishments of the Federal Government April 15, 1933, in connection with purchases of this article. The important differences between the revised and former specifications are as follows: 2 classes of brick have been eliminated and siliceous brick (over 65% silica) has been made a part of class H-75, but is optional with the purchaser. The P.C.E. of the highest heat-duty brick, class SH-75, has been changed from 31 to 32, and the number of cycles has been changed from 15 to 18 in the test for resistance to thermal spalling. The spalling test has been changed by reheating the end of the brick only instead of the entire brick, and spalling tests will be made using 2 in. of water for dipping instead of 4 in. No change was made in temperatures used. R.A.H.

Carbon monoxide disintegration. ANON. *Refrac. Bull.*, No. 12 (1932); abstracted in *Feuerfest*, 9 [1], 14 (1933).—The disintegration of grog brick by carbon monoxide because of the formation of carbon in the presence of catalyzers is explained. M.V.K.

Disintegration of fire brick. ANON. *Refrac. Bull.*, No. 13 (Jan., 1933); abstracted in *Chem. Trade Jour.*, **92** [2386], 118 (1933).—The slagging of a brick depends chiefly on (*a*) the constitution of the brick, (*b*) the constitution of the slag, and (*c*) the temperature. Probably the best basic idea is to consider that the brick and slag are always endeavoring to form low melting liquids, and in so doing the slag abstracts one or more constituents from the brick. Before the brick completely disappears into liquid, therefore, it is modified by these exchanges. A normal fire brick consists of mullite crystals ($3Al_2O_3{\cdot}2SiO_2$) + silica (cristobalite and/or tridymite) + siliceous glass ($SiO_2 + K_2O + Na_2O + CaO + MgO + FeO$). The rate of the initial reaction between the brick and the slag is controlled by the viscosity of the glassy bond, and this depends on the quantity of fluxes present in the glass. The mullite crystals, in the absence of flux, are stable up to 1800°, at which temperature they form corundum and liquid. In the presence of bases, however, they break down at much lower temperatures and, with alkalis and lime, form $RO{\cdot}Al_2O_3{\cdot}2SiO_2$ molecules which can form with the free silica still lower melting liquids approaching $RO{\cdot}Al_2O_3{\cdot}6SiO_2$ in composition and, with magnesia and ferrous oxide, liquids from which cordierite ($2RO{\cdot}2Al_2O_3{\cdot}5SiO_2$) crystals would tend to be formed. Briefly, the mullite in the brick is the source of alumina, some of which enters the liquid and some of which may remain as highly refractory, inert corundum. The free silica is a potential source of liquid formation all the time. The main factors which influence the activity of slag are as follows: (1) The nature and amount of active base available; *e.g.*, CaO and $FeO–Fe_2O_3$ account for the bulk of the industrial slagging of fire brick. (2) The viscosity of the slag. Thin, fluid slags permit relatively rapid reaction and diffusion of the migrating constituents. (3) The presence of even small quantities of acidic salts, such as sulfates, chlorides, or fluorides, greatly increases the activity of a slag. The influence of temperature on the rate of slagging of a brick can not be too strongly stated. The furnace temperature determines the viscosity of the glassy bond of the brick and of the slag. An increase of a few degrees is sufficient to halve the viscosity, so that as the brick bond and slag become more fluid the rates of reaction and diffusion are greatly accelerated. M.V.K.

"Carbex" silicon carbide brick. GENERAL REFRACTORIES CO. *Power*, **76** [6], 316 (1932).—Characteristics of the brick and illustrations of its application for boiler and industrial furnaces are presented. F.G.H.

Refractory Materials in Metallurgy. W. N. SCHWETZOW. Verlag für Maschinenbau, Metallbearbeitung, und Eisenmetallurgie, Moscow, 1932. 85 pp. *Jour. Inst. Metals*, **50** [11], 719 (1932). F.G.H.

Bauxite and Aluminous Laterite. C. S. FOX. *Jour. Inst. Metals*, **50** [12], 782 (1932); see also *Ceram. Abs.*, **11** [11], 577 (1932). F.G.H.

PATENTS

Process of producing alumina and phosphorus or phosphoric acid. ERLING JOHNSON (Odda Smelteverk A/S). U. S. 1,900,287, March 7, 1933. A process of producing alumina and phosphorus comprises smelting phosphate material and bauxite under reducing conditions in the presence of materials containing iron and sulfur in order to volatilize phosphorus and to form a slag containing aluminium compounds and

sulfides, treating the slag with a leaching liquor, and precipitating alumina from the solution so obtained.

Checker brickwork construction for regenerators. J. F. HYSLOP. U. S. 1,900,817, March 7, 1933.

Refractory porous diaphragm. R. E. LOWE, N. B. BROWN, AND WILLIAM BJORKSTEDT (Doherty Research Co.). U. S. 1,900,864, March 7, 1933. A method of making zircon refractories comprises mixing zircon grog with zircon fines, the grog consisting of particles passing through screens not substantially larger than 20-mesh and not substantially smaller than 40-mesh, the fines constituting between 5 and 20% by weight of the grog-fines aggregate, adding P_2O_5 to the aggregate, and firing the mass, the P_2O_5 by weight constituting not substantially less than 4% of the weight of the aggregate.

Method of manufacturing silica brick. B. J. PINES. Brit. 387,194, Feb. 8, 1933.

Terra Cotta

Discussion on "Conversion of periodic kilns from coal firing to natural gas for firing glazed clay products." CHARLES F. GEIGER. *Jour. Amer. Ceram. Soc.*, **16** [4], 203–204 (1933); see also *Ceram. Abs.*, **12** [4], 161 (1933).

Glaze adjusting for the plant executive who does not understand chemistry. II. PAUL E. COX. *Brick Clay Rec.*, **82** [1], 26–29 (1933).—In giving a detailed description of the use of a triaxial diagram, C. uses concrete examples of glaze mixes which are to be blended. The use of some of the different types of glazes obtained in the triaxial blending to produce colored glazes is taken up. A final set of rules regarding the effects of some of the oxides on colors is given. For Part I see *Ceram. Abs.*, **12** [3], 114 (1933). E.J.V.

Glazing and firing large terra cotta pieces. ATLANTIC TERRA COTTA CO. *Ceram. Ind.*, **20** [2], 68–69 (1933).—The production of a tympanum consisting of 13 free-standing figures in brilliant polychrome and gold ceramic glazes, 70 feet wide at the base and ranging to 12 feet in height, is described. The "Carbofrax" muffle kilns in which the pieces for the tympanum were fired are discussed. W.W.M.

Production of a gray salt-glazed ware. C. R. AUSTIN AND J. O. EVERHART. O. S. U. Eng. Expt. Sta. *News*, **3** [9], 5–7 (1932); *Ceram. Age*, **20** [2], 70–79 (1932).—Hollow tile manufactured in northeastern Ohio were tested to determine the possibility of obtaining a gray salt glaze. The procedure followed and results obtained are described. With the clays used the essential factors seem to be (1) sufficient temperature (2050 to 2100°F) to produce a gray color in the body, (2) a transparent glaze over the gray body (about six saltings), and (3) rapid cooling after the salting process is completed. The body must be ground to 20- to 28-mesh to avoid trouble from iron specks and a strong oxidizing atmosphere of about 150% excess air must be maintained throughout the salting and cooling periods. If flames touch the glaze it becomes yellowish in color. The ware is now being successfully produced. W.W.M.

Weathering of building stones from the chemical standpoint. RICHARD GRÜN. *Angew. Chem.*, **46** [1], 24 (1933).—Physical weathering agents which lead to the destruction of building materials are (1) heat, (2) frost, (3) salts crystallizing from solution, *e.g.*, gypsum, Na_2SO_4 (deterioration is due to the pressure of crystallization of the salts), and (4) infiltration, *i.e.*, the destruction of one stone by another; thus sandstone may be destroyed when in contact with stones containing lime. Sulfates are formed by contact with any sulfur trioxide from the air and deterioration results. The methods of testing the resistance of building stones to temperature changes and chemical attack are reported. L.T.B.

Preparing clays for roofing tile. E. HÜTTEMANN. *Tonind.-Ztg.*, **57** [6], 59–61 (1933).—The exactness of shape required for roofing tile differs for different types. Accordingly, the composition of the bodies may vary. The following factors influence the quality of the products: permeability and porosity, weather resistance and strength, and color of the tile. W.M.C.

Difficulties in the manufacture of flat roofing tile. ANON. *Tonind.-Ztg.*, **56** [99], 1216–17 (1932). W.M.C.

Warping of flat roofing tile. ANON. *Tonind.-Ztg.*, **56** [104], 1275–76 (1932). W.M.C.

Firing stoneware products. J. DORFNER. *Tonind.-Ztg.*, **56** [101], 1241–42 (1932).—This is a reply to the paper by Hauser (*Ceram. Abs.*, **12** [3], 114 (1933)). The strength of stoneware products is increased considerably by deposition of carbon

within the body. Therefore, firing should be done entirely in a reducing atmosphere. Kilns should be built accordingly. W.M.C.

Means of attaching terra cotta parts to buildings. F. THEILMANN. *Tonind.-Ztg.*, **57** [7], 72–75 (1933).—Methods are described which will protect terra cotta parts in buildings from attack by atmospheric influences. Illustrated. W.M.C.

The charm of the pantile. I and II. ANON. *Brit. Clayworker*, **41** [488], 300*A* (1932); [490], 360*A* (1933).—A discussion of the development of the pantile is given with a detailed description of the manufacture of the English and French flat and interlocking types. R.A.H.

Types of roofing tile. K. FRANK. *Tonind.-Ztg.*, **57** [10], 112–13 (1933). W.M.C.

Use of stoneware for monuments. A. HAMMER. *Tonind.-Ztg.*, **56** [104], 1276–79 (1932). W.M.C.

White Wares

Enamels of standard colors for vitreous china sanitary ware at cone 6. KARL M. KAUTZ. *Jour. Amer. Ceram. Soc.*, **16** [4], 192–98 (1933).

Fusion study of the high feldspar area in the feldspar–kaolin–quartz system. M. H. WALDSCHMIDT. *Jour. Amer. Ceram. Soc.*, **16** [4], 199–203 (1933).

Oscillographic investigations of the reactions taking place in the thermal breakdown of insulators. W. v. PHILIPPOFF. *Z. tech. Physik*, **14** [1], 21–23 (1933).—An electric insulator subject to alternating current will reach a stationary heat distribution after some time. If this stationary system should be disturbed, the heat will increase and the so-called "thermal breakdown" will occur. The investigations were carried out by means of a piezoelectric oscillograph. It was found that hysteresis may occur before the actual breakdown and that a new equilibrium may be obtained if means are provided allowing enough heat to escape. W.M.C.

Properties of high-tension porcelain in dependence on its composition. A. N. EGOROV AND I. M. TIKHOMIROV. *Keram. i Steklo*, **8** [12], 7–10 (1932).—A number of porcelain bodies was analyzed. The American high-tension porcelain was found to contain a large quantity of feldspar, the German, a high content of quartz, and the Russian, a high content of kaolinite. Masses with a high feldspar content have the best electrical and mechanical strength and highest physical properties. Clays from Borovichi are the most suitable for manufacturing high-tension porcelain. The porosity of porcelain bodies manufactured in U.S.S.R. is satisfactory when compared with foreign porcelain bodies. M.V.K.

Composition of porcelain. OVIDIO POLLASTRI. *Corriere Ceram.*, **13** [12], 441–51 (1932).—P. reviews briefly the origin, definition, classification (A. Brongniart), and history of porcelain, the preparation of raw materials, washing, grinding, and mixing, molding, glazing and firing, and the preparation of refractory mixes. M.V.K.

Porcelain of the European factories of the 18th Century. OTTO PELKA. *Sprechsaal*, **66** [1], 1–5 (1933).—Representative articles produced by European porcelain factories of the 18th Century are described and illustrated. W.W.B.

PATENTS

Lavatory. C. J. SANDHAGEN. U. S. 1,898,314, Feb. 21, 1933.

Water closet. SVEN DUNER. U. S. 1,898,656 and 1,898,657, Feb. 21, 1933.

Insulator. GUSTAV JANSSON (Condit Electrical Mfg. Corp.). U. S. 1,899,757, Feb. 28, 1933.

Treatment of steatite, etc. FELIX SINGER. Ger. 559,388, June 26, 1930. The thermal conductivity of steatite or ceramic masses containing steatite is raised by adding, prior to firing, a mixture of alkali metal compounds in such proportions that the number of molecules of the alkali oxide with the lowest molecular weight is more than one-half of the total number of alkali oxide molecules "calculated according to the Seger formula." (*C.A.*)

Equipment and Apparatus

Making pottery automatically. MILLER POTTERY ENGINEERING CO. *Ceram. Ind.*, **20** [3], 128–29 (1933).—A machine has been developed for the production of dinnerware that will do the work of 100 men. The machine is a unit of a production system developed by Wm. J. Miller and a commercial unit will be installed shortly in the plant of the W. S. George Pottery Co. Batting out and jiggering are done me-

chanically. The bat is released from the die by compressed air and the mold is held on a chuck by vacuum. The machine is coupled to the drier by a continuous conveyer. Only three men are required for its operation. Illustrated by photograph and line drawing showing flow sheet. W.W.M.

Reference tables for platinum to platinum-rhodium thermocouples. WM. F. ROESER AND H. T. WENSEL. Bur. Stand. *Jour. Research*, **10** [2], 275–87 (1933).—Reference tables for use with platinum to platinum-10% rhodium thermocouples have been prepared. When these tables are used the deviation curves obtained for individual couples have no points of inflection and are linear with few exceptions. These tables are based on the International Temperature Scale so that the indications of a thermocouple whose calibration is obtained by extrapolation of a deviation curve above the gold point will agree in this region with those of an optical pyrometer. R.A.H.

Thermocouple for determination of temperatures up to at least 1800°C. G. R. FITTERER. *Mining & Met.*, **14** [315], 170 (1933).—Radically different thermoelectric elements have been used in constructing a highly sensitive couple having the following characteristics: (1) It is useful up to and including temperatures far above the useful ranges of previously accepted couples, the melting points of the elements being approximately 2200 and 3000°C. (2) The thermoelectric variation with temperature is linear and the calibration curve may be reproduced after use at high temperatures for long periods of time. (3) The thermoelectric variation with temperature is reproducible, different couples of the same elements exhibiting similar calibration curves. (4) The thermoelectric power is large, *i.e.*, 300 microvolts per degree C, thus facilitating use of more rugged potentiometers than those in existence at present. E.J.V.

Measurement of surface temperatures. N. P. BAILEY. *Mech. Eng.*, **54** [8], 553–56 (1932).—A method for the determination of true surface temperatures is described. The effects of the following variables upon the measurement of surface temperatures were studied: (1) type of thermometer, (2) insulating materials used, (3) thickness of insulation for thermometer, (4) surface position of thermometer, whether vertical or horizontal, and (5) construction of thermocouples. Results show that mercury thermometers do not indicate surface temperatures with sufficient accuracy for experimental work, and that when they are used in commercial testing it should be remembered that they indicate, when referred to the ambient-air temperature, approximately 90% of the true difference between the surface and ambient-air temperatures. Thermocouples, however, when carefully made of small-gage wire and fastened to a surface with a covering of insulation, will indicate as high as 98.5% of the difference between the surface and the ambient-air temperatures. Illustrated with diagrams and graphs. F.G.H.

Development in temperature control equipment. FOXBORO CO. *Glass Ind.*, **14** [3], 33 (1933).—The potentiometer stabilog, an instrument combining the many features and advantages of stabilog control and potentiometer temperature measurement, provides 100% control up to temperatures of 2800°F. While it is a nonrecording instrument it can be connected to a recording potentiometer pyrometer using the same thermocouple. Illustrated. E.J.V.

Opportunities for using indicating and recording control instruments in the rock products industries. XI. Instrumentation in the ceramic industry. JAMES R. WITHROW. *Rock Prod.*, **36** [2], 32–35 (1933).—W. shows the place of instrumentation in the ceramic industry, including the manufacture of brick, tile, pottery, clay pipe, and insulators. The development, through instrumentation, of accurate temperature control has greatly increased the use of tunnel kilns. See also *Ceram. Abs.*, **12** [2], 70 (1933). W.W.M.

Experiments with recording pyrometer equipped with photoelectric cell. G. MÜLLER AND H. J. ZETZMANN. *Z. tech. Physik*, **14** [2], 90–94 (1933).—Short-time changes of temperature can not be measured with the ordinary type of pyrometers. On account of the long-wave radiation present, a high-vacuum photoelectric cell has been used with a cæsium coating. The temperature is recorded by means of a string oscillograph after d.-c. amplification. W.M.C.

Pyrometer controller. NEGRETTI AND ZAMBRI. *Jour. Sci. Instruments*, **10** [1], 22 (1933).—A pyrometer indicator and controller which works either on the thermocouple or electric-resistance principle is described. Illustrated. J.L.G.

Design for precision platinum resistance thermometers. J. A. HALL. *Jour. Sci. Instruments*, **10** [1], 4–10 (1933).—The resistance element is wound on a frame of fused quartz placed in a hermetically sealed envelope. Details of the construction and the methods employed are described. Evidence of the high precision which can be attained is presented. Illustrated with photos, diagrams, and curves. J.L.G.

Study of microscopic crystals by means of X-rays. Micro X-ray goniometer. O. KRATKY AND K. ECKLING. *Z. physik. Chem., B*, **19** [4], 278–90 (1932).—A camera is described which makes possible structural studies of microscopic crystals with the time of exposure comparable to that for macroscopic crystals. Diagrams of the camera and the arrangement of the apparatus are given. L.T.B.

Mirror spectrograph and monochromator for the visual region with an aperture of 1:3.5 or 1:2.5. O. SCHÖNROCK AND C. LEISS. *Z. tech. Physik*, **14** [2], 78–81 (1933).—A new type of mirror spectrograph has been developed which may be used, after slight alterations, as a monochromator. The mirrors are covered with a new alloy found by E. Hochheim, which exhibits good reflecting power in the ultra-violet. The spectrograph gives a satisfactory resolution, parallel light beams being almost symmetrical to the axis of the concave mirrors. W.M.C.

Induction separator. ANON. *Chem. Met. Eng.*, **40** [2], 95 (1933).—To meet new purity requirements in the manufacture of artificial abrasives and refractories, the Johnson induction magnetic separator was developed. The operation of the separator is described. It can be operated continuously without heating and with very low current consumption. It is recommended for use in ceramic plants and by producers of nonmetallic minerals such as bauxite, fluorspar, cyanite, barite, and feldspar. G.R.S.

Pneumatic transport and mixing in cement plants. K. A. GOSLICH. *Tonind.-Ztg.*, **57** [1], 5–6; [3], 26–29; [5], 50–52 (1933). W.M.C.

Portable air unloader. ANON. *Chem. Met. Eng.*, **40** [2], 98 (1933).—The machine is suitable for unloading such materials as potash, borax ore, soda ash, phosphate rock, etc. G.R.S.

Adapting the overhead chain conveyer to the layout. G. A. HOLMES. *Maintenance Eng.*, **91** [1], 6–9 (1933).—Data are given on the design, cost, and installation of overhead chain conveyers to fit varying conditions. Illustrated with 8 diagrams. J.L.G.

Correct width of transmission belts. H. KÖHLMANN. *Tonind.-Ztg.*, **57** [11], 130–31 (1933). W.M.C.

Theory and development of high temperature high-frequency furnaces. W. ESMARCH. *Z. tech. Physik*, **13** [12], 590–91 (1932).—The theory of high-frequency furnaces is outlined. The wave radiation emitted by the furnace coil strikes the charge of the furnace and is transmitted in it as a damp wave. The diameter of the charge may be larger or smaller than the wave-length. Only the first possibility is of a practical meaning, as in the second one diffraction and interference will prevent the absorption of energy in the furnace charge. The movement inside the melt is produced by pressure of the wave radiation on the surface of the melt. By preventing excessive heat radiation from the melt, temperatures of 3300°C may be obtained in that type of furnace. W.M.C.

Kanthal—electrical resistance alloy. ANON. *Machinery* [London], **41**, 192–93 (1932).—Kanthal is an alloy having higher resistivity, lower specific gravity, and greater resistance to sulfur attack than the nickel-chromium alloys. It is made in three grades, Al, A, and D, suitable for temperatures up to 1325, 1250, and 1150°C, respectively. F.G.H.

Resistance vacuum furnace. A. J. MADDOCK AND H. CHENEY. *Engineer*, **153**, 403 (1932).—A furnace is described for the heating under vacuum of small metal parts in order to degas them. F.G.H.

Keep electrical contacts clean. B. W. JONES. *Maintenance Eng.*, **91** [1], 4–5 (1933).—If the contact resistance between copper contact points builds up materially in use to overheat the electrical unit, the contacts must be cleaned regularly or some other material than copper must be used for the contacts. Silver is the one material that will give good results. It can usually be used in the form of a thin sheet brazed to the copper block. One graph. J.L.G.

Chrome platings of high corrosion and heat resistivity. G. HUTH. *Emailletech. Monats-Blätter*, **9** [2], 13–14 (1933).—A brief description of some of the newer chrome plating processes which produce platings with high resistivities to corrosion and to heat is given. E.J.V.

Fundamentals and economies in the clay industries. XXIII. ELLIS LOVEJOY. *Clay-Worker*, **99** [1], 23–25 (1933).—The radiated-heat drier is discussed and is compared with the waste-heat drier. The laying out of kilns and driers, kiln ducts and connections, and the proper construction of goose-necks are taken up in detail. The steam-heated drier is in the same class with the coal or gas-fired radiated heat drier. A maximum pressure can be built up easily in radiated-heat driers; it is difficult to obtain in the waste-heat type. The effect of this on dryingi s discussed. **XXIV.** *Ibid.*,

99 [2], 64–65 (1933).—E. discusses combined waste-heat and radiated-heat driers, terra cotta driers, pottery driers, sewer-pipe driers, firebrick driers, and the need for more progress in the drying process. For Part XXII see *Ceram. Abs.*, **12** [3], 118 (1933). E.J.V.

Cutting costs with drier car. B. L. SHULTZ. *Brick Clay Rec.*, **82** [1], 12–13 (1933).—This new drier car has a standard body, is mounted on a special running gear, and is so constructed that it can be operated over regular "T" rails or over a flat surface such as concrete runways or steel plates. In setting kilns it is possible to spot the cars where the setting is being done. Illustrated. E.J.V.

Drying brick. ADRIEN LEDUC. *Rev. mat. constr. trav. pub.*, No. 280, pp. 8–12*B* (1933).—L. describes an installation for drying brick in which heavy oil is used for the production of hot air. The advantages of artificial drying over natural drying and the mechanism of the drying process itself are discussed. M.V.K.

Swinging drier. G. HELM. *Ber. deut. keram. Ges.*, **13** [10], 454–57 (1932).—A patented drier consisting of pallets or shelves swung between continuous chains is described. Illustrated. E.J.V.

Portable hardness testing machine with diamond pyramid indenter. S. R. M. PORTER. *Jour. Sci. Instruments*, **10** [1], 18–20 (1933).—A diamond pyramid indenter is used with a high-power microscope allowing the load to be kept small enough to be applied directly by hand. The method of operation and sources of error are described. Illustrated. J.L.G.

Avery hardness testing machine. ANON. *Machinery* [London], **37**, 555–56 (1931).—An illustrated description is given of a machine which measures the depth of penetration of a ball or diamond under varying loads. F.G.H.

Chart for determining air density. H. C. OATLEY. *Power*, **77** [1], 40 (1933).—This is *Power's* data sheet, No. 6, for the graphical determination of air density from other observed factors. F.G.H.

Fan testing and performance as influenced by inlet duct. ANON. *Power*, **76** [7], 342–43 (1932). F.G.H.

Air conditioning. P. R. RANDALL. *Power*, **76** [6], 279–81 (1932).—The general types of equipment for air conditioning and their fields of use are reviewed. The silica gel calcium chloride conditioning units are described. F.G.H.

Influence of bends on performance of fans. ANON. *Power*, **76** [7], 343 (1932). F.G.H.

Storage of granular and powdered materials. R. HASBACH. *Tonind.-Ztg.*, **56** [99], 1221–22 (1932).—The silo storage plan is described. Illustrated. W.M.C.

BOOKS

Flotation Plant Practice. PHILIP RABONE. Mining Publications, Ltd., 724 Salisbury House, London, E. C. 2, England. Price 10/6. *Can. Chem. Met.*, **17** [2], 35 (1933).—This is a series of lectures on flotation methods and practices. The equipment described has been selected to conform with that employed in standard milling and flotation operations. Crushing, grinding, and preparation of ore, flotation reagents, flotation machines, specific applications of methods to particular ores, disposal of tailings, and filters are discussed. E.J.V.

Physics of High Pressure. P. W. BRIDGMAN. Reviewed in *Jour. Geol.*, **41** [1], 106 (1933); for abstract see *Ceram. Abs.*, **11** [1], 63 (1932). G.R.S.

Treatise on Sedimentation. W. H. TWENHOFEL, *et al.* 2nd ed. 960 pp. Williams and Wilkins, Baltimore, 1932. Reviewed in *Jour. Phys. Chem.*, **37** [2], 261–62 (1933). G.R.S.

Theory of the Coreless Induction Furnace. (Zur Theorie der eisenlosen Induktionsöfen.) R. B. RADULET. École polytechnique fédérale, Zürich, 1931. 82 pp., with 13 illustrations. *Jour. Inst. Metals*, **53** [2], 110 (1933). F.G.H.

Treatise on Optical Pyrometry. GUSTAV RIBAUD. Encyclopédie Photometrique, 5th section, Measures on Emission, Volume 4. xvi + 485 pp. Published by Revue d'Optique Théorique et Instrumentale, Paris, 1931. Reviewed in *Nature*, **131** [3301], 151 (1933); see also *Ceram. Abs.*, **11** [4], 257 (1932). J.L.G.

Improved methods of industrial degreasing. DOW CHEMICAL CO. *Special Development Bull.*, No. 18; *Power*, **76** [7], 384 (1932). F.G.H.

PATENTS

Clayworking and conditioning. WALTER ASCHE. U. S. 1,898,333, Feb. 21, 1933.

Method and machine for extruding plastics. T. F. MOONEY (Ludowici-Celadon Co.). U. S. 1,898,381, Feb. 21, 1933.

Method of producing pottery and molds for use therewith. W. J. Miller. U. S. 1,898,561, Feb. 21, 1933.

Brick mold. J. A. Crowell (J. B. Crowell & Son). U. S. 1,898,715, Feb. 21, 1933.

Checker brick molding machine. F. M. Miller. U. S. 1,899,708, Feb. 28, 1933.

Process of making brick. F. M. Miller. U. S. 1,899,709, Feb. 28, 1933.

Pot-forming machine. F. Y. Pearne and William McClintock (F. R. Galbreath). U. S. 1,899,881, Feb. 28, 1933.

Machine for manufacturing ceramic objects. T. F. Mooney (Ludowici-Celadon Co.). U. S. 1,899,974, March 7, 1933.

Apparatus for producing various kinds of pottery. R. L. Cawood. U. S. 1,900,797, March 7, 1933.

Kilns, Furnaces, Fuels, and Combustion

Basic laws and data of heat transmission. I. General survey. W. J. King. *Mech. Eng.*, **54** [3], 190–94 (1932). **II. Conduction.** *Ibid.*, **54** [4], 275–96 (1932). **III. Free convection.** *Ibid.*, **54** [5], 347–53 (1932). **IV. Forced convection.** *Ibid.*, **54** [6], 410–26 (1932). **V. Radiation.** *Ibid.*, **54** [7], 492–97 (1932). **VI. Evaporation and condensation.** *Ibid.*, **54** [8], 560–65 (1932). F.G.H.

The "mol." E. F. Dawson. *Power*, **76** [6], 292–94 (1932).—The use of the mol and mol fractions in combustion computations involving flue gases and gaseous fuels is presented in a practical manner. F.G.H.

Kiln for both continuous and periodic runs. Anon. *Tonind.-Ztg.*, **56** [102], 1253–54 (1932).—A kiln similar to a zigzag kiln is described which can be run continuously for common brick in the summer and periodically for hard-fired brick in the winter. Several ways of enlarging the kiln are discussed. Illustrated. W.M.C.

Output of ring and zigzag kilns. P. Thor. *Tonind.-Ztg.*, **57** [10], 114 (1933). W.M.C.

Setting brick in the ring kiln. Anon. *Tonind.-Ztg.*, **56** [101], 1244–45 (1932). W.M.C.

Building materials for the tunnel kiln. F. Singer. *Tonind.-Ztg.*, **57** [10], 118–20 (1933).—This is a reprint of a chapter from the new book by Singer, The Tunnel Kiln. W.M.C.

Importance of repairing brick kilns in the proper way. Anon. *Tonind.-Ztg.*, **57** [5], 48–49 (1933). W.M.C.

Method of adjudging coals. R. A. Mott and R. V. Wheeler. Midland Institute of Mining Engineers (advance paper); *Colliery Guard.*, **145** [3748], 797–800 (1932); *Power Fuel Bull.*, **23**, 159 (1932).—The fundamental property of a coal, in regard to its ability to cake when heated, is its swelling power. This property, although modified by the rate of heating, is essentially dependent on the chemical constitution of the coal. It was found that the most strongly swelling coals contain between 85 and 88% carbon and more than 5.5% hydrogen. Within the same range of carbon content, coals that contain less than 5.25% hydrogen have only medium swelling power. A table of the swelling powers of coals and their uses is given. E.J.V.

Determination of moisture content of coal. H. A. J. Pieters and H. Koopmans. *Chem. Weekblad*, **29**, 509–13 (1932); *Gas Age-Rec.*, **71** [9], 226 (1933).—For ordinary technical purposes it is satisfactory to dry coal in air at a temperature of 105°C, but more accurate results are obtained by drying at the same temperature in a stream of carbon dioxide gas and weighing the evolved water, or by distillation with xylene. E.J.V.

Combustion of pulverized coal. Grebel. *Génie civil*, April, 1932; abstracted in *Ind. chimique*, **20** [228], 26 (1933).—G. describes the theories of the combustion of coal, lighting, and flame, and shows that the essential characteristic of the combustion of pulverized coal is the total length of time of combustion of the grain under conditions of industrial practice. The following factors greatly influence the duration of combustion: (1) fineness of the grain, (2) specific surface, (3) ash content, (4) humidity, (5) chemical nature, (6) excess of air, (7) different velocities of grains and air, (8) preliminary preheating of air and its humidity content, (9) the average course of the flame, (10) velocity of aëration, (11) types of generators, etc. These various factors are discussed in detail. See also *Ceram. Abs.*, **11** [4], 263 (1932). M.V.K.

Diffusion combustion and its application to glassmelting. P. Q. Williams. *Glass Ind.*, **14** [2], 13–21 (1933).—The principle of diffusion combustion makes possible the following improvements over old methods: (1) an increased melting rate with a sub-

stantially lowered flame temperature; (2) refractory wear is localized reducing routine repairs to the minimum; (3) the melting process is stabilized insuring consistent quality and uniform results; and (4) the melting unit is compact and self-contained. Diffusion combustion has two different functions, (*a*), increased radiation which effects heat transfer, and (*b*) the control of the convection currents in the glass by the control of heat liberation. In explaining diffusion combustion W. discusses luminosity and radiation, emissivity, sources of radiant energy, characteristics of diffusion flames, facts confirmed by performance, diffusion combustion as applied to glassmelting, diffusion combustion in the glass tank, importance of controlled convections, devitrification, and scum enhanced by poor convection. Illustrated. E.J.V.

Abating the smoke nuisance. A. C. STERN. *Mech. Eng.*, **54** [4], 267–68 (1932).—The use of steam-air jets to supply overfire air and overfire turbulence for the reduction of smoke in the burning of bituminous coal is described. F.G.H.

BOOKS AND BULLETINS

Comparative data on solid, liquid, and gaseous fuels. COMMITTEE OF TEN. Coal & Heating Ind. of Chicago, *Bull.*, No. 6, 25 pp. (1932); *Power*, **77** [2], 100 (1933). F.G.H.

Technical Data on Fuel. H. M. SPIERS. Reviewed in *Power*, **77** [1], 49 (1933); for abstract see *Ceram. Abs.*, **11** [11], 588 (1932). F.G.H.

Pulverized Coal, Coal Dust, and Their Applications. (Le charbon pulvérisé, le poussier de charbon, et leurs applications.) H. BLEIBTREU. Dunod, Paris, 1932. xii + 546 pp. Price 164 F. *Jour. Inst. Metals*, **50** [12], 781 (1932). F.G.H.

Twenty-Fifth Report of the Pulverized Fuel Committee of the Reich Fuel Council. (25th Berichtefolge des Kohlenstanbausschusses des Reichskohlenrates.) V. D. I. Verlag, Berlin, 1932. 62 pp. 62 illustrations. Price 2 M. *Power*, **77** [1], 49 (1933).—The report contains six papers on the subject presented during 1929, 1930, and 1931. F.G.H.

Second report on the back-run process for the manufacture of carbureted water gas: 31st Report of the Joint Research Committee of the Institution and Leeds University. F. J. DENT, W. H. BLACKBURN, N. H. WILLIAMS, E. PARRISH, AND A. R. KELLY. *Inst. of Gas Engrs., Copyright Pub.*, No. 58, 163 pp. (1932).—Thorough tests were made on the differences in operation and the results obtained in a carbureted water-gas plant with back run or down-run operation. Primarily because of the return to the generator of heat convected by the back-run steam from the carbureter and superheater, there is less heat absorbed in the generator for every unit of gas made. Therefore, there is less heat to be supplied by the gasification of C in air during the blow and a consequent measurable increase in thermal efficiency and output. The introduction of back-run steaming can then be used to obtain a reduction in coke consumption, an increase in the volume of gas made per day, or both. A test with a back-run cycle showed a reduction of 3.8 lb. of coke per 1000 cu. ft. of blue water gas and an increase of 6.9% in the daily volume of gas as compared with a test on a down-run cycle making 390 B.t.u. gas or 4.6 lb. and 9.7% for 490 B.t.u. gas. Against these gains are the reductions in the amount of steam raised in the boilers, 18 lb. per 1000 cu. ft. of blue water gas in these tests. To replace this, 2.35 lb. of coke would be required. Details are given in 24 tables. Part of the H_2S in the gases leaving the generator was absorbed if those gases passed through the carbureter and superheater on the way to the wash box, because of its reaction with the FeO in ash on the checker brick. Back-run steam releases some of this H_2S. Data are given on the variation in composition and rate of production of gas in blow and run periods, the oxidation and reduction of coke ash in the fuel bed, the efficiency of a Centriflovane grit catcher, the use of a Sturtevant crusher and Fuller mill, and methods of gas analysis. (*C.A.*)

Study of the characteristics of burning gas with preheated air. ANON. *Amer. Gas Assn. Rept.*, No. 685 (1932); *Foundry*, **61** [1], 49 (1933). F.G.H.

Research in the elimination of noise in industrial gas burners. ANON. *Amer. Gas Assn. Rept.*, No. 692 (1932); *Foundry*, **61** [1], 49 (1933). F.G.H.

Standard nomenclature for industrial gas combustion systems. ANON. *Amer. Gas Assn. Rept.*, No. 694 (1932); *Foundry*, **61** [1], 49 (1933). F.G.H.

PATENTS

Car-type furnace suitable for firing ceramic ware. J. H. KNAPP (J. H. Knapp Co.). U. S. 1,881,683, Oct. 11, 1932.

Sand seal for tunnel kilns. E. B. FORSE AND C. F. GEIGER (Carborundum Co.). U. S. 1,898,042, Feb. 21, 1933.

Pressure gas producer. KARL KOLLER. U. S. 1,899,158, Feb. 28, 1933.

Gas burner suitable for brick-firing furnaces. G. E. SEIL. Brit. 348,639, Feb. 15, 1929. (*C.A.*)

Geology

Fluorspar deposits in western states. ERNEST F. BURCHARD. *Mining & Met.*, **14** [314], 112 (1933).—Fluorspar is found in most of the western states and has been mined in Ariz., Colo., Nev., N. M., Utah, and Wash. E.J.V.

Purification of fluorspar for ceramics. V. CHARRIN. *Céram. Verrerie*, No. 844, p. 543 (1932).—Fluorspar must be pure for use in glass manufacture in which the total impurities must be less than 1% and iron oxide less than 0.12%. This degree of purity is obtainable by tabling and flotation processes. M.H.B.

Italian kaolin. ANON. *Chim. & ind.*, **29** [2], 492 (1933).—Italian kaolin which, in spite of its very high quality, is little used by the Italian ceramic industry is discussed. M.V.K.

Clay in South Africa. A. W. CARRUTHERS. *Official Yearbook of S. Africa*, **13**, 469 (1932).—Kaolin occurs over large areas but is not worked except on the Cape Flats, where it is not associated with granite, and in Natal. Fire clays of excellent quality occur in the coal measures separated from the coal by 100 ft. or more. Fire brick and crucibles are made at Boksburg. Pottery clay is worked at Olifantsfontein, but the manufacture of white china has been discontinued. Brick clay is universal throughout the Union, and pipe, tile, etc., are produced on a large scale. H.H.S.

Barite deposits in North Carolina. JASPER L. STUCKEY AND HARRY T. DAVIS. *Mining & Met.*, **14** [314], 4 (1933).—Deposits of barite are found in N. C. in the Hot Springs, Kings Mountain, and Hillsboro areas. E.J.V.

Alberta bentonitic clays. ANON. *Can. Mining Met. Bull.*, No. 251, p. 166 (1933).—Alberta bentonitic clays are being used by Claynett Products, Ltd., as a base for toilet and beauty preparations. The company is said to be building a plant at Edson, Alberta, southwest of the clay deposit. G.M.H.

Magnesite deposit discovered near Cranbrook, B. C. EDITORIAL. *Can. Mining Met. Bull.*, No. 250, pp. 78–79 (1933).—The Geological Survey of Canada has announced the discovery of a large and conveniently situated deposit of crystalline rock magnesite. G.M.H.

Occurrence of andalusite, cyanite, sillimanite, and staurolite in Chittering Valley. EDWARD S. SIMPSON. *Jour. Roy. Soc. W. Australia*, **18**, 75–82 (1931–32) (reprint).—Highly metamorphosed sediments carry much quartz and biotite, less muscovite, frequent occurrences of sillimanite, cyanite, chlorite, and staurolite, and more rarely corundum, garnet, and andalusite. The andalusite has been altered to mica. The sediments are split into bands by granite or granitic gneiss. The whole complex is cut by dikes of epidiorite and related greenstones. Small quartz veins are common and are associated in several places with cyanite and sillimanite. (*C.A.*)

Beryl from Eritrea. ANON. *Chim. & ind.*, **29** [2], 491 (1933).—Large beryl deposits have been discovered in the Ghedem mountains in Eritrea. It is an amorphous mixture of metasilicate of glucinium and a double metasilicate of glucinium and aluminum, and corresponds to the formula $4BeSiO_3$, $Al(SiO_3)_3$; compared with ordinary beryl having the formula $3BeSiO_3$, $Al(SiO_3)_3$. M.V.K.

Problem for the ceramic industries. V. CHARRIN. *Céram. Verrerie*, No. 841, pp. 365–66 (1932).—V. discusses possible uses for the residue obtained by carbonizing oil-bearing schists for their petroleum content. M.H.B.

Chromium. I. ANON. *Ind. chimique*, **20** [228], 10–11 (1933).—The properties and use of chromium and its alloys are discussed. Forty-one per cent of the chromite mined is used in the refractory industry, 46% in metallurgy, and 13% in the chemical industry. The values of various chromium minerals of different countries are given in a table. M.V.K.

BOOKS

Simple Geological Structures. JOHN I. PLATT AND JOHN CHALLINOR. Thomas Murby and Co., London, D. Van Nostrand, New York. 56 pp. Reviewed in *Jour. Geol.*, **41** [1], 110 (1933).—This is a laboratory manual presenting nine map exercises with detailed explanatory notes intended for classes in historical geology. G.R.S.

The Mineral Industry of the British Empire and Foreign Countries. IMPERIAL INSTITUTE. H. M. Stationery Office, London, 1932. 398 pp. Price 6s. *Jour. Inst. Metals*, **50** [12], 782 (1932). F.G.H.

St. Peter and Older Ordovician Sandstones of Northern Arkansas. ALBERT W. GILES. Ark. Geol. Surv. *Bull.*, No. 4, 181 pp. (1930); reviewed in *Jour. Geol.*, **41** [1], 108–109 (1933).—This report was intended to facilitate the utilization of the St. Peter, Calico Rock, and King's River sandstones. The physiography and structure of the sandstone region are well treated. These sands are valuable for glass manufacture, filter sands, refractories, foundry sands, road building, and general building purposes. G.R.S.

Fundamental Problems of Geology. (Grundprobleme der Geologie.) S. VON BUBNOFF. Gebruder Borntraeger, Berlin, 1931. 237 pp. Reviewed in *Jour. Geol.*, **41** [1], 110 (1933).—This book is an introduction to geologic thought. Geologic phenomena in their widest range are discussed in such a manner as to emphasize the problems involved and to lead to their critical consideration. G.R.S.

Handbook of Geophysics. (Handbuch der Geophysik.) ANON. Vol. I, Part I, 308 pp.; Vol. II, Part I, 456 pp.; Vol. III, Part I, 570 pp.; Vol. IV, Parts I and II, 685 pp.; Vol. VI, Part I, 312 pp. Gebruder Borntraeger, Berlin, 1931. Reviewed in *Jour. Geol.*, **41** [1], 99–101 (1933).—The Handbook of Geophysics when complete will comprise the following ten large volumes: I, the earth as a planet, II, the structure of the earth, III, changes in the earth's crust, IV, earthquakes, V, magnetic and electrical phenomena, VI, geophysical prospecting methods, VII, physics of the hydrosphere, VIII and IX, physics of the atmosphere, and X, general considerations. G.R.S.

German-English Geological Terminology: An Introduction to German and English Terms Used in Geology, Including Mineralogy, Petrology, and Mineral Deposits. A. CISSARZ AND W. R. JONES. *Jour. Inst. Metals*, **50** [12], 782 (1932); for abstract see *Ceram. Abs.*, **12** [4], 171 (1933). F.G.H.

Chemistry and Physics

Constitution of the calcium aluminate hydrates and their double salts in complex chemical representation. LENNART FORSEN. *Angew. Chem.*, **46** [3], 67 (1933).—The following compounds were prepared: $2CaO{\cdot}Al_2O_3{\cdot}7(5)H_2O$; $3CaO{\cdot}Al_2O_3{\cdot}18(6)H_2O$; $3CaO{\cdot}Al_2O_3{\cdot}12(6)H_2O$; $3CaO{\cdot}Al_2O_3{\cdot}6(6)H_2O$; $4CaO{\cdot}Al_2O_3{\cdot}13(7)H_2O$; $3CaO{\cdot}Al_2O_3\cdot\cdot CaX_2{\cdot}10(6)H_2O$ (X = Cl, Br, I, NO_3, ClO_3); $3CaO{\cdot}Al_2O_3{\cdot}CaSO_4{\cdot}12(6.5)H_2O$; $3CaO\cdot\cdot Al_2O_3{\cdot}3CaOSO_4{\cdot}31.5(7.5)H_2O$. The figures in parentheses represent the amount of water at 105° or over P_2O_5. These compounds are orthoaluminates with anions $(Al(OH)_6)^{+++}$ or metal aluminates with the anion $(Al(OH)_4)^+$. The orthoaluminates are similar to the orthophosphates. The loosely combined water of the compounds may be considered bound to the Ca, *e.g.*, $(Ca(OH_2)_4)_2\ (Al(OH)_6)_2$, which may also be written $3CaO{\cdot}Al_2O_3\cdot\cdot 18H_2O$. The compound $4CaO{\cdot}Al_2O_3{\cdot}13H_2O$ is well defined and contains no free lime. The action of calcium salts as a retarder of the set of aluminates depends on the formation of an insoluble double salt of the aluminate in limewater. L.T.B.

Preparation of models for the equilibrium $CaO{\cdot}MgO{\cdot}Al_2O_3{\cdot}SiO_2$ constructed on the basis of former studies. E. JÄNECKE. *Angew. Chem.*, **46** [1], 22 (1933).—The investigations of the Carnegie Institute in Washington were used for the respresentation and construction of this model of the quaternary system. L.T.B.

Volumetric determination of calcium and magnesium in the presence of one another. EMÖD V. MIGRAY. *Chem.-Ztg.*, **56**, 924 (1932).—The proposed method is recommended for the determination of hardness in softened water. To the hot, slightly acid solution containing only Ca, Mg, and alkali salts, add an excess of N $(NH_4)_2C_2O_4$ and make slightly ammoniacal. Boil the solution a few minutes to make the CaC_2O_4 precipitate crystalline, make acid with 2 N AcOH, add some N Na_2HPO_4 solution, make ammoniacal, and boil about 5 min. Filter and wash with water, using suction, until the precipitate is neutral. Transfer the precipitate from the filter to a porcelain dish, heat to about 90°, add 2 drops of methyl red indicator solution, and titrate with 0.1 N HCl. The acid used corresponds to that necessary to dissolve $MgNH_4PO_4$, forming Mg^{++}, $H_2PO_4^-$, and NH_4^+. Now add 7 N H_2SO_4 until the CaC_2O_4 is dissolved and titrate the liberated oxalic acid with $KMnO_4$. (*C.A.*)

Rational method for the analysis of natural magnesium silicates. M. BICHOWSKY AND J. GINGOLD. *Angew. Chem.*, **45** [51], 785–87 (1932).—The analysis of the natural hydrous magnesium silicates, such as the talcs, is very complicated. The authors propose modifications for a more rapid analysis. Data are given and methods compared. L.T.B.

Determination of indium and gallium with 8-oxyquinoline. W. GEILMANN AND

F. W. WRIGGE. *Z. anorg. allgem. Chem.*, **209** [2], 138 (1932).—A method is described for the quantitative determination of these elements. L.T.B.

Quantitative crystal analysis by the Debye-Scherrer method and its practical application. W. BUESSEM. *Angew. Chem.*, **46** [3], 68 (1933).—X-ray determinations were made of the amount of free lime in the system CaO–Al_2O_3. The method of analysis depends on the fact that in a mixture of several different compounds, the intensities of the lines are in the same ratio as the weight ratios of the components. In the determination of $3CaO \cdot Al_2O_3$ in $3CaO \cdot SiO_2$ 4% of $3CaO \cdot Al_2O_3$ can still be identified, so that on firing only a small miscibility of the silicate and aluminate must be assumed. L.T.B.

On the "Pauly method" of determining the refractive indices of liquids. F. C. PHILLIPS AND W. A. WOOSTER. *Z. Krist.*, **84** [3–4], 318–20 (1933).—After a number of experiments the authors were unable to find any justification for the inclusion of this method among the standard methods for determining the refractive indices of liquids. G.R.S.

Spectrographic analysis. E. H. S. VAN SOMEREN. *Jour. Inst. Metals*, **53** [2], xxvii (1933).—S. describes (1) the development of spectrum analysis, (2) various methods of exciting spectra, (3) the qualitative control of materials by spectroscopic methods, (4) methods of obtaining quantitative results, (5) spectroscopic methods applied to mineralogical analysis, (6) metallurgical applications of the method, and (7) the future of spectrum analysis. F.G.H.

Spectroscopy as an aid in metallurgical analyses. S. J. LEWIS. *Metallurgist* (Supp. to *Engineer*), **7**, 28–30 (1931).—L. gives examples of the spectrographic and chemical analyses of three materials to illustrate the value of spectrographic control in quantitative analytical work. F.G.H.

Characteristics of clays for their technical use by mineral analysis. H. HARKORT. *Angew. Chem.*, **46** [3], 69 (1933).—H. discusses the value of a mineral analysis of clays for the production of better products. L.T.B.

Hydrogen ion measurement and control. P. L. MANN. *Amer. Dyestuff Reporter*, **22** [5], 167–68 (1933).—The measurement and control of the hydrogen ion content of solutions and its application to control in the textile industry are discussed. J.L.G.

Dehydration of hydrogels in the presence of various gases. GUSTAV HÜTTIG AND KURT STRIAL. *Z. anorg. allgem. Chem.*, **209** [3], 249–56 (1932).—If hydrogels or hydrates of metallic oxides are dehydrated at moderate temperatures, oxides in a relatively reactive or catalytic state are obtained. The type of oxide finally obtained depends to a great extent on the gas used for dehydration. The amount of water which remains in the oxide finally is characteristic for each gas used and is reproducible. The oxide hydrates studied were those of Cr, Zr, and Th. The drying gases included in the studies were N_2, H_2O, air, C_2H_5OH, CH_3OH, and NH_3. L.T.B.

A new arrangement for vapor-pressure measurements by transfer and its use in the pneumatolytic transfer of Al_2O_3 by HCl or Cl_2. WERNER FISCHER AND RUDOLPH GEWEHR. *Z. anorg. allgem. Chem.*, **209** [1], 17–32 (1932).—If a gas is passed over a substance, volatilization may occur if the material vaporizes. A nonvolatile substance may be obtained in the form of a vapor by allowing a gas to pass over it which reacts with it to form a product which exists in the form of a vapor. If the conditions are then changed, *e.g.*, if the temperature is lowered, the original material may again be separated. This process is similar to sublimation. Reactions of this type have recently been called pneumatolytic. The reactions of a halogen or of a halogen acid on certain oxides are pneumatolytic reactions; thus, $2Al_2O_3 + 6Cl_2 = 4AlCl_3 + 3O_2$. If the heat involved in this reaction is negative for the left to right direction, then the decomposition at high temperatures must proceed from left to right and at low temperatures from right to left. The action of HCl and Cl_2 on Al_2O_3 was studied for temperatures above 1000 °C. The amount of alumina which was volatilized was determined. The variation of the partial pressure of the gas phases taking part in the reaction was tested from the standpoint of the mass law. The reaction may be written thus: $Al_2O_3 + 6HCl = 2AlCl_3 + 3H_2O - 68$ k. cal. Detailed experimental results are given. L.T.B.

Rôle of sodium aluminate in accelerating separation of solid phases during water-softening operations. L. M. CLARK AND L. S. PRICE. *Jour. Soc. Chem. Ind.*, **52** [6], 35–44 (1933).—Separation of solid phases from solutions of calcium and magnesium salts of the concentrations dealt with in water softening practice is discussed. G.R.S.

Pressure of saturated water vapor on the range 100 to 374 °C. N. S. OSBORNE, H. F. STIMSON, E. F. FIOCK, AND D. C. GINNINGS. Bur. Stand. *Jour. Research*, **10** [2], 155–88 (1933). R.A.H.

The cation and water economics of ceramic clays in the raw state. K. ENDELL AND P. VAGELER. *Ber. deut. keram. Ges.*, **13** [9], 377–411 (1932).—A brief discussion is presented of the electrochemical theory of adsorption compounds, the quantitative determination of cations in complexes and in balanced solutions of ceramic clays, and the significance of the coating of complexes with cations on (*a*) drying shrinkage, hygroscopicity, and plasticity, (*b*) castability, and (*c*) washability. There is a functional connection between the total absorption capacity, T, and the linear drying shrinkage corresponding to the hyperbolic equation, % linear drying shrinkage $= \frac{18 + T}{18T}$. The drying shrinkage, hygroscopicity, and plasticity of clays and kaolins were once functions of the adsorption capacity, T, of the complexes for cations, but first of all with a given T value they are functions of the individual hydration of the univalent cations contained in the T value. The liquefaction of the clays, elutriability with electrolyte additions, and filterability of clays is also improved. Tests showed the following results: (1) reduction of plasticity and production of first class fireclay brick with the maximum reduction of the grog addition; (2) possibility of increasing the plasticity of kaolins, clays, and nonplastic bodies; (3) shortening the drying time by the adjustment of optimum atmospheric moisture at the beginning of the drying process for thick-walled ceramic products; (4) judging and advance determination of the optimum castability of refractory clays and kaolins; (5) economic advantages of the rational elutriation of kaolins with electrolytes; (6) relation between the p_H value and water content of the slip for washing kaolins. E.J.V.

Data. XIII. T. W. GARVE. *Clay-Worker*, **99** [2], 63 (1933).—G. takes up radiation and gives the formula for calculating the quantity of heat radiated, radiation coefficients for various materials, pipe heat losses in B.t.u./ft./°F/hour for steam and for water, and pipe radiating surfaces per linear foot of standard sized pipes. For Part XII see *Ceram. Abs.*, **12** [3], 130 (1933). E.J.V.

Melting under pressure. E. JÄNECKE. *Z. physik. Chem.*, *A*, **162** [4–5], 286–88 (1932).—J. discusses van Laar's equation for expressing the melting relations. This equation does not give a maximum melting temperature at infinitely high pressures so that the interpolation formulas given formerly are no longer useful for expressing the solid-liquid equilibrium at high pressures. L.T.B.

Transformations in homogeneous materials. G. TAMMANN. *Z. anorg. allgem. Chem.*, **209** [2], 204–12 (1932).—These transformations are (1) transformations in the softening range of glasses in which the properties change in a manner different from that above or below the interval, (2) similar behavior in some crystalline materials (both types of change are reversible), and (3) transformation of a solidified cold-worked metal into the soft state. This is not a reversible change, as is the change from the unstable crystalline form into the stable. T. discusses only the theory of the reversible transformations in crystals and illustrates with examples from various systems. L.T.B.

Crystal structure of β-zirconium. W. G. BURGERS. *Z. anorg. allgem. Chem.*, **205** [1–2], 81–86 (1932); *Metals & Alloys*, **3** [10], 296 (1932).—At 862 ± 5°C there is a change of modification of zirconium metal. The crystal structure of the modification stable above this temperature was determined by means of X-rays. The lattice is body-centered cubic with two atoms in the unit cell. The length of the unit cube = 3.61 Å, determined at a temperature just above the transition point. An X-ray camera for the production of rotation photographs of heated wires is described. The photographs may be made in vacuum or in any gas. L.T.B.

Crystal structure of cerussite. M. Y. COLBY AND L. J. B. LACOSTA. *Z. Krist.*, **84** [3–4], 299–309 (1933).—A determination of the complete crystal structure of cerussite ($PbCO_3$) was carried out on the basis of oscillation photographs. The unit cell has 4 molecules and has the dimensions $a = 5.16$ Å, $b = 8.46$ Å, and $c = 6.14$ Å. The space group is V_h^{16}. G.R.S.

Crystal structure of sulvanite, Cu_3VS_4. LINUS PAULING AND R. HULTGREN. *Z. Krist.*, **84** [3–4], 204–12 (1933).—The study by means of Laue and oscillation photographs of the cubic mineral, sulvanite, showed the unit of structure to have $a_0 = 5.370$ Å and to contain $1Cu_3VS_4$. The space group and atomic arrangement are given. G.R.S.

Crystal structure of borides of the composition MeB_6. M. v. STACKELBERG AND F. NEUMANN. *Z. physik. Chem.*, *B*, **19** [5], 314–20 (1932).—The structures of the compounds CaB_6, SrB_6, BaB_6, LaB_6, CeB_6, PrB_6, NbB_6, and ErB_6 were determined from powder X-ray photographs. L.T.B.

Removal of iron from ceramic raw materials. R. STAUFER AND K. KONOPICKY. *Tonind.-Ztg.*, **57** [11], 126–27 (1933).—In the process developed by Alterra, Inc., sulfuric

acid is used with ferrous sulfate and a small amount of ferric sulfate. The latter will greatly increase the solubility of the ferrous sulfate. The cost for 10 tons of material is estimated at about $8.50. W.M.C.

Separation of beryllium from other elements by guanidine carbonate. A. JÍLEK AND J. KOTA. *Z. anal. Chem.*, **89**, 345–54 (1932); *Analyst*, **57**, 799 (1932); see also *Ceram. Abs.*, **11** [11], 594 (1932). H.H.S.

BOOKS

Recent Advances in Atomic Physics. Vols. I and II. G. CASTELFRANCHI. Translated by W. S. Stiles and J. W. T. Walsh. P. Blakiston's Son & Co., Philadelphia, 1932. Reviewed in *Jour. Phys. Chem.*, **37** [2], 265–68 (1933). G.R.S.

Handbook of Chemistry and Physics. Edited by C. D. HODGMAN. 17th ed. Chemical Rubber Publishing Co., Cleveland, 1932. xiii + 1722 pp. $6.00. *Jour. Inst. Metals*, **50** [11], 717 (1932). F.G.H.

Introductory Course in Physical Chemistry. W. E. RODEBUSH. 421 pp. D. Van Nostrand Co., New York, 1932. Reviewed in *Jour. Phys. Chem.*, **37** [2], 262–65 (1933). G.R.S.

Textbook of Physical Chemistry. Vol. I. General Properties of Elements and Compounds. J. N. FRIEND. Charles Griffin & Co., London, 1932. 413 pp. Price 24s. *Jour. Inst. Metals*, **53** [1], 58 (1933). F.G.H.

Chemical-Technical Research Methods. (Chemisch-technische Untersuchungsmethoden.) E. BERL AND G. TUNGE. Julius Springer, Berlin, 1932. xlviii + 1380 pp. *Jour. Inst. Metals*, **53** [1], 57 (1933). F.G.H.

Comprehensive Treatise on Inorganic and Theoretical Chemistry. Vol. XII. U, Mn, Ma, Re, Fe. J. W. MELLOR. Longmans, Green & Co., Ltd., London, 1932. xiii + 944 pp. 178 illustrations. Price 63s. *Jour. Inst. Metals*, **50** [12], 783 (1932); for Vol. XI see *Ceram. Abs.*, **11** [6], 393 (1932). F.G.H.

Introduction to the Scientific Study of the Soil. N. M. COMBER. 208 pp. E. Arnold and Co., London, 1932. Reviewed in *Chem. & Ind.*, **52** [4], 86 (1933). G.R.S.

Handbook of Spectroscopy. (Handbuch der Spektroskopie.) H. KAYSER AND H. KONEN. S. Hirzel, Leipzig, 1932. iv + 654 pp. *Jour. Inst. Metals*, **53** [1], 58 (1933). F.G.H.

Industrial Microscopy: A Book Dealing with the Use of the Microscope and the Preparation of Specimens. W. GARNER. Isaac Pitman & Sons, Ltd., London, 1932. vii + 389 pp. Price 21s. *Jour. Inst. Metals*, **50** [11], 716 (1932). F.G.H.

Quantitative Analysis. E. G. MAHIN. 4th ed. McGraw-Hill Book Co., New York, 1932. 623 pp. $4.00. *Mech. Eng.*, **54** [9], 666 (1932). F.G.H.

Modern Methods in Quantitative Analysis. A. D. MITCHELL AND A. M. WARD. Longmans, Green & Co., Ltd., London, 1932. 169 pp. *Jour. Inst. Metals*, **50** [8], 526 (1932). F.G.H.

Chemical Analysis by X-Rays and Its Applications. (The George Fisher Baker Non-Resident Lectureship in Chemistry at Cornell University, Volume 10.) G. v. HEVESY. *Jour. Inst. Metals*, **50** [11], 717 (1932); for abstract see *Ceram. Abs.*, **12** [4], 173 (1933). F.G.H.

X-Rays, Past and Present. V. E. PULLEN AND W. J. WILTSHIRE. Benn, London, 1932. 229 pp. *Jour. Inst. Metals*, **50** [9], 589 (1932). F.G.H.

Microchemical Laboratory Manual. F. EMICH AND F. FEIGL. John Wiley & Sons, Inc., New York, 1932. 180 pp. $3.00. *Jour. Inst. Metals*, **50** [8], 525 (1932). F.G.H.

Extraction of Aluminum Oxide and Metallic Aluminum from Clays of the Bobrikow Beds of the Moscow Coal Mines. L. G. KOBLENZ. Mochimenergostroj, Moscow, 1932. 94 pp. *Jour. Inst. Metals*, **50** [10], 651 (1932). F.G.H.

PATENTS

Production of white lead. J. W. ILIFF AND W. J. LINDSAY (National Lead Co.). U. S. 1,898,054, Feb. 21, 1933.

Method of preparing a lead-carbonate product. S. S. SVENDSEN (George Birkenstein). U. S. 1,898,405, Feb. 21, 1933.

Process for producing double compounds of aluminum fluoride-alkali fluoride. HEINRICH SPECKETER AND JULIUS SÖLL (I. G. Farbenindustrie A.-G.). U. S. 1,898,506, Feb. 21, 1933.

Method of producing crystalline hydrates of alkali metal silicates. C. L. BAKER (Philadelphia Quartz Co. of California, Ltd.). U. S. 1,898,707, Feb. 21, 1933. (1)

The method of making crystalline sodium metasilicate includes preparing a solution calculated to satisfy the water requirements of a predetermined crystal composition and effecting crystallization thereof while maintaining the temperature between the melting temperature of the predetermined crystal composition and that of the crystal of the next lower melting point. (2) Crystalline sodium metasilicate in a stable hydrous form is a new article of manufacture.

Process for making pigmentary base product. A. V. BLOM. U. S. 1,899,132, Feb. 28, 1933. A pigmentary base of the character described comprises the product produced by the oxidation of a lead alloy containing substantially 85% lead, 13% antimony, and 2% tin, the oxidation having been carried out at a temperature between 250 and 280°C.

General

Proportion of lime, phosphate, and soda. W. J. RYAN. *Power*, **76** [6], 286–87 (1932).—A practical presentation is given of various calculations involved in figuring the amounts of chemicals to be used for treating boiler feedwater. F.G.H.

Air control steps up stoker performance. J. H. WALKER. *Power*, **76** [6], 282–84 (1932).—The basic idea in sectionalized air control is to adjust the air flow to each small subdivision of the fuel bed independently of changes in fuel-bed resistance. Hence a local thinning of the bed does not cause an increased flow of air because flow is controlled and progressive unbalancing of the fuel bed can not even start. F.G.H.

Heating and drying granular materials by convection. W. GILBERT. *Engineer*, **150**, 500–502, 530–32, 574–75, 587–89, 617–19, 640–42 (1930).—The results show the great advantage of drying in a current of hot air as compared with furnace drying. F.G.H.

Radiation in the visible region of incandescent oxides and mixtures of oxides. H. HOPPE. *Ann. Physik*, **15** [6], 709–28 (1932).—The radiation of binary oxides such as those used in the mantle of a gas burner was investigated. Oxide mixtures of a non-colored oxide which will not radiate in the visible region with a colored one of a strong emission in the visible were tested. ZrO_2, SnO_2, Nd_2O_3, CeO_2, and their mixtures were used. The influence of grain size and the change of radiation as a function of the temperature were determined. With decreasing grain size (smaller than 1μ) a decrease of radiation was observed. Transparent white sapphire and ruby were investigated. The sapphire does not radiate at all in the visible region up to a temperature of 1500°K. See also *Ceram. Abs.*, **11** [8], 468 (1932). W.M.C.

Danger of dust in pneumatic sandblasting. L. GREENBURG AND C. E. A. WINSLOW. *Arch. Gewerbepath. Gewerbehyg.*, **3** [4], 577–99 (1932); abstracted in *Chim. & ind.*, **29** [2], 324 (1933).—The dust in the air breathed, particularly quartz particles, creates in the workman a high predisposition toward silicosis when abrading pneumatically. When using steel instead of sand, less dust and much less quartz is present in the air. However, it is possible to operate pneumatic sandblasting under good conditions by means of modern devices. The use of helmets with air pressure and glass shields for the eyes protects the workman, and the quantity of dust in the air breathed is small. M.V.K.

Results of silicate research. ANON. *Tonind.-Ztg.*, **56** [100], 1228–29; [102], 1254–55 (1932); for abstract see article by Kühl, *Ceram. Abs.*, **12** [4], 174 (1933). W.M.C.

Wisconsin foundries coöperate in solving silicosis problem. E. O. JONES. *Foundry*, **61** [1], 16 (1933).—Group action of the Wis. foundries has afforded them protection and has pointed the way to preventive procedures in solving silicosis problems. The cooperative program of study followed during the past two years in connection with the problem of damage claims based upon alleged health impairment due to inhaling silica dust is described. F.G.H.

Report of General Secretary Ross C. Purdy. EDITORIAL. *Bull. Amer. Ceram. Soc.*, **12** [3], 59–67 (1933).

Research for industrial pioneering. J. P. FERRIS. *Mech. Eng.*, **54** [4], 249–53 (1932).—The need for the coördination of research efforts and the intelligent selection of subjects for research work is emphasized. The university and other noncommercial laboratories can be most effective in guiding industrial development by adhering to three principles: (1) Each research project undertaken should be something that would not be done at all or not as well if left to a private agency. (2) Attempts should be made to minimize duplication of effort in research. (3) The objective of each project should contribute to something which is socially desirable or something which needs to be done. F.G.H.

Influence of the world crisis on the ceramic and glass industries of the capitalistic countries. D. G. MUZ'IKANTSKII. *Keram. i Steklo*, **8** [11], 12–17 (1932).—An economic review of the state of the ceramic and glass industries outside of Russia is given. M.V.K.

"Carry on" is the cry of the common brick industry. ANON. *Brick Clay Rec.*, **82** [2], 50–51 (1933); *Clay-Worker*, **99** [2], 52–55 (1933).—A detailed report is given of the sixteenth annual meeting of the C. B. M. A., now the Brick Manufacturers Association of America, at Washington, February, 1933. E.J.V.

Paving brick men face future with enthusiasm and determination. ANON. *Brick Clay Rec.*, **82** [2], 53–54 (1933).—The National Paving Brick Assn. proposes research to broaden the use of paving brick, protests against the diversion of the gasoline tax from highway funds, and is interested in the possibility of using off-grade pavers in reinforced brick masonry. E.J.V.

National Brick Manufacturers Research Foundation. ANON. *Clay-Worker*, **99** [2], 60–62 (1933).—Reports read at the second annual meeting in Pittsburgh, February, 1933, showed that considerable progress has been made in reinforced brick masonry. E.J.V.

Meeting competition with new products in glass, enamel, and pottery. ANON. *Ceram. Ind.*, **20** [2], 77–83 (1933).—New products and new ideas in merchandising are expected to increase sales in the glass, enamel, and pottery fields. W.W.M.

Energy economy in ceramic plants. KARL LEHNARTZ. *Ber. deut. keram. Ges.*, **13** [10], 457–65 (1932).—The possibility of economy from the standpoint of energy consumption in a ceramic plant is discussed under the following headings: thermal value of the power-producing material, selection of power on a price basis, the fuel consumption from the viewpoint of the progress of firing with regard to the fuel, periodic high-fired kilns, continuous high-fired kilns, muffle kilns, air and steam for drying purposes, production of steam, the present-day state of ceramic kilns, and suggestions for improvements. E.J.V.

Scheme of international duties for the ceramic industry. ANON. *Tonind.-Ztg.*, **57** [3], 23–25; [5], 53–54; [6], 63–65 (1933).—The department of economic relations of the League of Nations has been editing a scheme for unifying the duties. A number of items covering materials used in the ceramic industry and their explanation are given. W.M.C.

BOOKS

Profitable Practice in Industrial Research. Edited by M. ROSS, M. HOLLAND, AND W. SPRAGUEN. Prepared under the direction of the National Research Council. Harper & Brothers, New York, 1932. 269 pp. Price $4.00. Reviewed in *Mech. Eng.*, **54** [8], 594 (1932).—This is a symposium by the directors of some of the greatest industrial research laboratories of the U. S. Among the topics discussed are (1) the philosophy and practical application of industrial research; (2) the organization of research departments; (3) the selection of research workers; (4) research work in foreign countries; (5) the part played by trade associations, the government, and universities; and (6) the transference of the results of research to the industrial plant. F.G.H.

Handbook on Pottery and Glassware. ANON. Scott, Greenwood & Son, London. Price 5s net. *Pottery Gaz.*, **58** [669], 364 (1933).—The revised edition contains information on the manufacture of pottery and glassware, a glossary which explains the terms used in the industries, and a new chapter on salesmanship. E.J.V.

Directory of the Glass and Ceramic Industries of Czechoslovakia and Austria. JOSEPH F. RIMPLER. Published by Allgem. Glass und Keram. Ind., 1931–1932. 45 kronen. Reviewed in *Feuerfest*, **9** [1], 12 (1933).—A directory is presented of glass plants, porcelain manufacturers, exporters, and industries related to ceramics of Czechoslovakia and Austria. M.V.K.

PATENTS

Process of coloring granular material, etc. P. S. DENNING (F. E. Schundler). U. S. 1,898,345, Feb. 21, 1933.

Process of manufacturing porous silica ware. LUDWIG KERN. U. S. 1,898,839, Feb. 21, 1933.

For you to realize

the importance of the

American Ceramic Society

it is suggested that you

attempt to compile a

list of facts you have

originated wholly unin-

fluenced by the findings

of others

THREE ELEPHANT

Reg. U. S. Pat. Off. Reg. U. S. Pat. Off.

AND BORIC ACID

GUARANTEED OVER 99.5% PURE

AMERICAN POTASH & CHEMICAL CORPORATION

Woolworth Building, New York

THE ADVANCED TECHNIQUE OF PORCELAIN ENAMELING

A new complete text on Porcelain Enameling that has met with instant approval from the industry.

Price $3.50—Copies sent on approval
Write for yours today.

FERRO ENAMEL CORPORATION

CLEVELAND, OHIO

WENNING CERAMIC COLORS

"CERAMIC" COLORS

WILL GIVE YOU

MOST COLOR AT LEAST COST

ANTIMONY OXIDE
BLACK NEEDLE ANTIMONY
COBALT OXIDE
CHROME OXIDE
CADMIUM OXIDE
COPPER OXIDE
IRON OXIDE
UNDERGLAZE COLORS & OVERGLAZE COLORS
GLAZE STAINS
GOLD & SILVER
SODIUM ANTIMONATE

"Ceramic" Colors are used by leaders in the Ceramic Industry because of their fine quality. They have greater strength, brilliancy, purity and are always uniform. All "Ceramic" Colors are tested and must be approved before they are shipped.

VITRIFIABLE COLORS & ENAMELS

For Spraying and Decorating

GLASS, POTTERY, TILES and BRICK

Special Colors for Your Individual Requirements

CERAMIC COLOR AND CHEMICAL MANUFACTURING CO.

NEW BRIGHTON, PA. U. S. A.

Refractory Materials

Products of the Electric Furnace

SILICON CARBIDE
SILICON CARBIDE FIRESAND
ARTIFICIAL MULLITE
FUSED ALUMINUM OXIDE
FUSED MAGNESITE

Furnished in raw material form, ground to meet specifications.

Our Research Department with fully equipped laboratories is always at your service.

WRITE US ABOUT YOUR PROBLEMS

THE EXOLON COMPANY

Established 1914

Electric Furnace Plant { THOROLD, ONTARIO

Finishing Plant, General Offices { BLASDELL, N. Y.

FINEST POTTERY CLAYS

BULLETIN

of the

AMERICAN CERAMIC SOCIETY

A Monthly Publication Devoted to Proceedings of the Society, Discussions of Plant Problems, Discussions of Technical, Scientific, and Art Questions, and Promotion of Coöperative Research

Edited by the Secretary of the Society Assisted by Officers of the Industrial Divisions

L. E. Barringer, E. deF. Curtis — Art
A. I. Andrews, W. N. Harrison — Enamel
H. H. Blau, S. R. Scholes — Glass
H. F. Kleinfeldt, V. V. Kelsey — Materials and Equipment
R. A. Heindl, H. E. White — Refractories
J. O. Everhart, W. C. Rueckel — Structural Clay Products
Walter Timmerman, E. L. Murray — Terra Cotta
Louis Navias, R. F. Geller — White Wares

OFFICERS OF THE SOCIETY

John C. Hostetter, President
Corning Glass Works, Corning, N. Y.
L. J. Trostel, Vice-President
General Refractories Co., Baltimore, Md.
H. B. Henderson, Treasurer
1445 Summit St., Columbus, Ohio
Ross C. Purdy, General Secretary and Editor
Emily C. Van Schoick, Assistant Editor
2525 N. High St., Columbus, Ohio

TRUSTEES

E. V. Eskesen
E. P. Poste
C. L. Sebring
W. C. Lindemann
F. C. Flint
V. V. Kelsey
J. M. McKinley
R. B. Keplinger
R. L. Clare
D. P. Forst

Vol. 12 **May, 1933** **No. 5**

EDITORIAL

BUY AMERICAN AND GIVE AMERICANS WORK*

By L. D. Odhner

In my opinion, the most serious problem which has ever faced the American nation is the present problem of unemployment in which we find nearly one-third of the nation's bread winners deprived of the means of earning food, shelter, and clothing for themselves and their families, in spite of the fact that as a nation we have more of everything that our people require, than is necessary to meet our demands. If this condition is allowed to increase, as it has during the past three years, we can not avoid a crumbling from within of our whole economic structure that will destroy us as one of the world's great nations.

The history of the world shows that nations have been able to survive almost any kind of external aggression regardless of how severe it may have been. France, at one time was reduced to a mere fraction of her present boundaries by conquests by the English, Germans, and the Italians and yet today she has come back to a point where her boundaries include practically all of the French speaking people in Europe. Poland lost her existence as an independent nation for nearly a half century and yet today

* Presented at the Annual Meeting, American Ceramic Society, Pittsburgh, Pa., February 16, 1933 ("Buy American" Program).

we find her identity restored and she is taking her place again among the nations of Europe.

On the other hand, nations which have been destroyed from within never come back. The Roman Empire and the tremendous empire of Alexander the Great were destroyed from within and no vestige of them was left nor did they ever reappear in the world's history.

For this reason I feel that the greatest patriotic duty that faces every American today is that of helping to secure work for the unemployed in order to preserve this great country of ours. Unfortunately, however, as the growth of unemployment increases this patriotic duty, our individual ability to meet it decreases through a decline in our earning power. Almost all of us are making much less money today than we did in 1929 and therefore are much less able from our own financial means to hire people outright. We are forced consequently to look for some other way in which we can help to create work for those who have been deprived of it.

As a Chamber of Commerce secretary, I, more than the average man, have to listen to speeches and read articles suggesting solutions for our present economic difficulties. All that I have seen or heard to date, however, with the exception of the Buy American plan, are so remote and so theoretical that as an individual I feel that they are entirely out of my reach except insofar as they may work themselves down through the wheels of government until they appear on the ballot in some form or another on which I can vote either yes or no.

I am not content as an American to let my responsibility in helping to solve the unemployment situation rest with a mere vote. It is my duty to take an active part personally in helping to cure this awful disease. The only thing that has come to my attention so far that will help to cure it, in which I can participate personally and in which everybody else in this country can participate personally, is the matter of buying American and giving Americans work.

I know that when I go to the merchants' stores I can find out whether or not the goods offered were made in America and if they are foreign goods that could have been made over here as well or better, I can refuse to buy them. I know too that everybody else in this country can do the same thing. Buying American, therefore, seems to be the one proposal for relieving unemployment that is within the power of every patriotic American to carry out.

Having arrived at this conclusion, we must next give thought to the question of whether or not this proposal contains a boomerang that eventually will do more harm to the American worker than good, that eventually will rather deprive Americans of employment than it will give them employment. The two great objections which are brought against the Buy American campaign are (1) the settlement of our international debts and (2) the maintenance of our export trade which is said to be essential to the continuation of American business.

Let us first take up the matter of debts. These debts were all created prior to 1920, nearly 13 years ago. Since 1920, of the whole $11,678,093,000 borrowed, nothing has been repaid and only some $2,515,013,000 of the interest has been paid and yet since these debts were created, America, during the decade from 1920 to 1930, enjoyed the greatest period of business activity in her entire history. All of the halcyon prosperity of this decade took place without the replacement of a single nickel of the principal of our international debt. It must be evident therefore, that the replacement of these debts is not essential to the restoration of business activities in this country. I do not advocate the cancellation of the foreign debts; in fact I oppose it, but to permit these debts to be paid at the expense of the American worker through the importation of cheap foreign manufactured goods is the worst bargain we could possibly make.

It would only mean greater unemployment and increase the danger of the destruction of our country. And the very nations that are begging us to permit them to pay their debts through selling us their cheap manufactured goods are the nations whose own governments officially are financing and managing buy-at-home campaigns within their own borders.

Next let us consider international trade. Here we must point out that in advocating buying American we refer not to the goods which we must have and can not supply ourselves, but only to those goods which we are equipped to make either as well or better than the nations from which we import them or, if they are raw materials, of which we have a sufficient supply to meet our needs. The only sound basis of any kind of trade, local or international, is necessity. If we do business for any other purpose, disastrous results are certain, just as was evidenced in the collapse of the real estate boom in 1925 and of the securities boom in 1929. During the real estate boom, necessity was not the basis for buying and selling real estate, but only speculation. Land was bought not for its earning value but for what it could be sold for. During the securities boom, practically no concern was given to the true earning value of the securities, but only the price that they might bring the next day or the next week.

Now let us consider American exports. Everything we export, with few exceptions, is bought by foreign nations because of necessity. Either they do not manufacture the products we make and must have them or else the quality of our products is so superior to those made in other nations that they are necessary to the business of those nations in order to compete with other business. Let us take typewriters for example. Nearly 40% of all typewriters manufactured in America are exported. Thus countries which do not make them must import the typewriters they use and the American typewriter is so superior to those that are made in a few foreign nations that there is no comparison and even the business houses in those countries are practically compelled to buy American typewriters.

This same thing applies to almost all of our other manufactured exports. *In scarcely no case are American exported manufactures bought because of price.* This is self-evident because our labor rates range from 100 to 600% and 700% higher than the rates paid in all foreign countries. We can not compete with foreign nations on a price basis. On the other hand, practically all manufactured goods which are imported into this country are not imported because of necessity, but because of price, in order that greater profit may be made from them in competition with our own manufactured goods. This is an absolutely unsound basis of international trade and should be discontinued. We do not bring them in because we need them, but simply to make a greater profit in competition with ourselves. It is practically insanity. Any business that goes into competition with itself can not survive.

It is as unsound as the transient merchant, a disease which has inflicted most American communities during recent years. The merchandising district of a community is that which gives the community individuality and character. Without a merchandising center a community can scarcely be said to exist as an independent unit. The local established merchant invests his money in land, building, and stock. He pays taxes to the community and contributes his time and his funds to community and civic activities. His best business month of the year is December. He performs an indispensable community function in that he carries in stock things that the people of the community can get when they want them. Along comes the transient. He leases a store for the thirty days of the Christmas shopping season. He loads up the store with distress merchandise picked up at random throughout the country. He offers this merchandise to the people at prices from 25 to 50% lower than the prices

that the established merchant can sell for and remain in business. The unthinking people of the community rush to his store in order to take advantage of the questionable bargain which the transient offers and the transient leaves after the holiday season with the cream of the community's Christmas business. He is not there to stand behind the goods he has sold and when the public finds out the quality of the goods it has bought, it has no recourse. In the meantime, the established merchant has lost his best month's business and may have to close his store, thus depriving the community of an important business institution. No one with common sense would question the fact that patronizing the transient merchant is unsound business for the inhabitants of the community and yet patronizing these transient merchants is exactly comparable to buying the goods of foreign nations because they are cheaper than the products of our own factories. Importation of manufactured goods because of price can lead to nothing else than the depressing of the standard of living of our own workers to a degree as low as the standard of living of the foreign nations from whom these imports are coming. Such a catastrophe is unthinkable.

Let it also be borne in mind that there never was such a thing as a balance of trade between nations. For years the United States has been Brazil's greatest customer through our purchases of coffee and chocolate. Brazil, on the other hand, practically refuses to purchase American manufactured goods and prefers to buy from England and Germany. This condition has existed for years but it has never occurred to Americans not to buy Brazilian coffee in retaliation for Brazil's refusal to purchase American manufactured goods.

The United States is the greatest customer of the Malay Peninsula and the Dutch East Indies because of the rubber that we purchase from them. And yet the Malay Peninsula and the Dutch East Indies make practically all their purchases from England and Holland.

On the other hand we have the British Isles. For more than a generation, their purchases from this country have been from two to three times as great as their sales to America. Why? Because they must have our cotton, even though they have been making strenuous efforts to increase the production of cotton in Egypt, India, and other places within the British Empire. This illustrates the fact that *need* is the one basis of international trade and that it will dictate the amount of business done between nations regardless of how lopsided that trade may be. Where a trade is carried on for the purpose of competing against the already established business of our own country that trade should be stopped.

Let us next consider what other nations are doing in the matter of fostering buy-at-home campaigns and then determine what America should do for herself. We shall start with Great Britain because Great Britain for generations has been the world's greatest international trade and if encouraging a buy-at-home campaign is destructive to international trade, then Great Britain has more at stake than any other nation. This nation, Great Britain, has held herself together as a unit since the time when William the Conqueror won the Battle of Hastings in 1066. She has never been threatened with a serious revolution. The War of the Roses and the Cromwellian uprising were her only serious troubles in nearly a thousand years of existence and they are not to be compared with the severity of the French Revolution, the Russian Revolution, or our own Civil War. Surely this must be a tribute to the wisdom of Great Britain's government. Then again, Great Britain has been able to hold together a worldwide Empire longer than any other nation in this world's history. This too must be a tribute to the wisdom of her government.

Is it reasonable, therefore, to conclude that a nation which has such a record for good government has suddenly thrown caution and common sense to the wind and is

threatening herself with destruction through an unsound fostering of a buy-at-home campaign? The Buy British campaign was started four years ago. The British government itself carries it on. Why has Britain done this? We must bear in mind that England was suffering from a depression long before America even thought of one. While we were basking in the ecstatic joys of the Coolidge prosperity, Great Britain was struggling with the dole. She has had more time to think about this problem than America and during that time she has come to this great and far-reaching realization that the same rules which govern the individual human being are the rules which govern a nation, operating of course on a much broader scale, and of all these rules the most outstanding one which has impressed itself upon the British mind is that inevitable rule which the sick man must follow if he wants to recover. When a man is seriously ill he has no other recourse but to isolate himself from his fellow-men, confine himself to the sick bed, and use all of his own strength and resources for his own recovery.

Just as this rule applies to the individual, Great Britain has applied it to the nation. She has realized that as a nation she has been seriously ill economically and that her only solution in this crisis is to follow the rule for the sick man, to isolate herself, figuratively speaking, from her fellow-nations and to use all of her great strength and resources for her own recovery.

France has seen the same thing in sponsoring her "Achetez Français" campaign, the Buy French campaign conducted by the French government. Mussolini has carried out this rule ever since he became Dictator and now has Italy in better condition than she has enjoyed for several centuries. Germany is doing the same thing and Greece, with Mr. Insull and his ten million dollars in ten thousand $1000 United States bills, is trying to follow suit.

As an evidence of the success of the British campaign, let me quote from the Toronto Industrial News Bulletin No. 36, which was published by the Toronto Industrial Commission on January 7, 1933.[1]

> A substantial increase in the percentage of Canadian trade with Great Britain and a drop in the proportion of trade with foreign countries, notably the United States, are revealed in official government statistics for the month of October. Britain's share of Canadian purchases abroad in October was the largest in 21 years; that of the United States, the smallest since the beginning of the present century.

With this band of nations surrounding the United States fostering local buy-at-home campaigns, what has been the result on American business? We have been exporting factories instead of the products of our factories. Last year American business built more than 1500 plants in foreign countries. They built these plants in order to preserve the foreign business which was being taken away from them by the local buy-at-home campaigns, but what Americans must remember is this, that all of those men in this country who formerly were making the goods for foreign countries that are now made in the foreign plants of American concerns have nothing to do and there never will be any work for them unless it is created through patronizing our own manufactures.

What effect has the importation of these cheap foreign goods on the American worker? During 1930, well-known economists in America estimated that $1000 spent would create work for a man for a year. This estimate was based on the fact that $1000 put into circulation turns over twenty-two times, which means that it does twenty-two thousand dollars in business. Ten per cent of that turn-over goes to the payroll. In other words, $2200 goes to payroll and in 1930 that was considered the income of a man for a year. Today it would be more like the income of a man

---

[1] Item 3, on p. 2, headed, "Canadian Trade with Britain Up."

for two years. For the sake of conservatism, however, we shall use the 1930 figures and consider that each $1000 spent furnishes work for a man for a year.

Now let us look at the destruction we have wrought through needless importation of goods from foreign countries. We shall not start with the manufactured products, as an illustration, but with a raw material, crude oil, because it is the most inexcusable importation of all. Every one last year read of the use of the militia by the governors of Oklahoma and Texas to cap the oil wells of those states in order to stop overproduction. Oil wells in California were also capped for the same reason and while troops were being used to deprive the American workers of their jobs, some of our oil companies were bringing in (during 1932) thirty million dollars worth of crude oil. Thirty thousand thousands dollars; thirty thousand men thrown out of a year's income because of the greed of some people to make a greater profit.

If we think of these men as the supporters of the average American family of four and as assembled in one community, they would make up a city of more than 120,000, as large as Trenton, N. J., Reading, Pa., or Paterson, N. J. If a catastrophe such as this should actually happen, if every inhabitant of the city of Paterson, N. J., at one fell stroke, were to be deprived of one year's income, it would be a cataclysm so terrible that it would be emblazoned on newspapers throughout the world, and yet that is what we have done through the needless importation of crude oil from foreign countries.

Crude oil at least can be refined in American refineries and thus furnish some work for American people, but what then of the fact that during 1933 we imported $20,000,000 in refined petroleum products, 20,000 men thrown out of work for a year, enough to support the entire city of Bayonne, one of the biggest refinery towns in this country.

And why should Americans have imported $4,200,000 of coal during 1932 when starvation is rampant throughout the coal regions of our country, or $10,000,000 worth of cheese while our farmers are on the point of rebellion because of their inability to sell their own products? Or $7,200,000 worth of meat when they are getting so little for their livestock that it hardly pays to feed them? The cheese business alone would be enough to give 10,000 men work for a year, or support a city of from 40,000 to 50,000 people.

Nothing is more startling than the amount of money which we pay to insurance companies of foreign countries annually for fire, marine, and re-insurance policies alone. It amounted in 1931 to $168,829,205 and this does not include life, accident, or any other form of insurance, which would add many more millions to this figure.

So we might continue to mention item after item, *ad infinitum*, electric light bulbs, soap, handkerchiefs, shoes, rag rugs, pottery, but these details are superfluous. Any one who is interested in securing accurate facts can find them in the report of the United States Department of Commerce on "Foreign Commerce and Navigation of the United States." The complete figures for 1932 are yet not available but during 1931 America imported one billion dollars worth of foreign manufactured goods and foreign raw materials that we are equipped to make or mine over here as well or better than the countries from which we import them. A billion dollars is a million thousand—a million men deprived of work for an entire year or if we view it from the standpoint of the four cruel winter months of December through March, we could put three million men to work during these months to supply the needs of our nation which we are now buying from foreign countries simply because they offer us a slight advantage in price. If we could remove three million families from the relief rolls of this nation it would make such a change in present conditions that it would at least remove the emergency phase of this depression and it might start us back on the road to prosperity.

In conclusion, in spite of what nationally known economists may say to the contrary, this depression is not like all other depressions that this country has experienced. In

no previous depression was there a Russia, a nation of 170 million people trying out a new economic system diametrically opposed to our own, and not only trying it out, but paying propagandists to spread it in other nations. Today there are fourteen million unemployed in this country; fourteen million people deprived of the self-respect that they derived through earning a living; fourteen million people unable to furnish food, clothing, and shelter for their dependents; fourteen million people hungry and dissatisfied; fourteen million people who are ripe material for the propaganda of the agitator who would destroy the great foundations on which the world's most wonderful nation was founded. We can not expect these people to be reasonable if we are going to allow them to remain unemployed. We can not expect them to be patient year after year when they know that this country has more of everything than all of its people require. Any sensible man knows that unless we find work for these people they are going to become impatient and want a change and any sensible man knows that however right the Bolshevist system may be for Russia, it is not the right thing, in its present condition, for the United States, a nation of educated and free people. The greatest single patriotic duty facing every person in this country is that of helping to find work for the unemployed and there is no way that is more within the reach of every person in the country to accomplish this than to buy American and give Americans work.

BUY AMERICAN ASSOCIATION
613 NORTH AMERICAN BLDG.
PHILADELPHIA, PA.

THE SILICOSIS RACKET

Ceramic Abstracts have listed such reports on silicosis as have appeared in the world's ceramic literature. Judging from the very few references to silicosis and dust problems appearing in the *Abstracts*, the ceramic industries have not been seriously concerned about this problem.

Frederic Willson read an address at our 1932 Annual Meeting in Washington on silicosis and its prevention. His address was not made public because of the suits then pending against the Pennsylvania Pulverizing Company. On September 29, 1932, a decision in the U. S. Circuit Court of Appeals found that the Pennsylvania Pulverizing Company had not been negligent in providing dust-removal systems, in providing masks, and in warning the employees of the hazards of their work, and therefore a verdict was rendered in its favor.

In March this year the W. A. Case and Sons Manufacturing Company, with a pottery plant at Robinson, Ill., successfully defended itself in a U. S. Court in a $50,000 damage suit. This company had previously settled four suits and six more are pending.

This racket has just begun in the ceramic industries. The Locke Insulator Company, the Pfaudler Company, the Corning Glass Works, and the Scammel China Company have been sued. It has flourished in the foundries in those states where workmen's compensation acts do not cover industrial diseases. The Merchants Dispatch Company (N. Y. Central Lines subsidiary) is said to have settled 64 cases out of court. There have been about 125 common law suits in Rochester, N. Y., and vicinity since last summer.

It is only in California, Connecticut, Massachusetts, North Dakota, Wisconsin, and the District of Columbia that such cases would come under the compensation acts. In all other states such damage suits have to be tried under the common law or statutes.

Quoting from *The Foundry*, October, 1932, issue:

In those states where silicosis and kindred sicknesses are controlled by the workmen's compensation act there is not so much activity in stirring up claims, as the amount

to be recovered is limited by the statutes. Under practically all workmen's compensation acts the payments are made in weekly installments, and the rights of the claimant are still subservient to the powers of the industrial commission, even after trial. In other words, if an award is erroneous as to the extent of disability, the respondents or defendants can file petitions to have the same corrected by offering additional evidence and proof of the physical condition of the claimant.

In the common law courts, however, there is no limitation as to the amount to be recovered except in a few states where there is a statutory limit on recoveries for death. The judgment in a lump sum is final after the defendant has appealed to the court of last resort, and it is usually paid in a lump sum. After the judgment becomes final it is impossible practically in all jurisdictions to change it as to amount, even though newly discovered evidence indicates that the condition of the plaintiff was exaggerated at the trial. As the fees of ambulance chasers range from one-third to one-half of the sums recovered, it can readily be seen that it is a racket which appeals to chasers, unscrupulous lawyers, and doctors who put the dollar ahead of the ethics of their profession.

In the May, 1933, *Journal of The American Ceramic Society* is a report of an investigation presented by Edward Schramm. This paper reports actual dust counts with no air circulation or dust removal at the dustiest places in the plant and also the effectiveness of the installed dust-removal systems.

With suits pending against foundries aggregating several hundred thousands, and with lawyers and erstwhile laborers looking for easy money, the ceramic industries must realize that they must prepare to defend themselves.

Andrew J. Farrell of the Claim and Legal Department, Central West Casualty Company, Chicago (see *Industrial Medicine*, October, 1932), and Harold S. Falk of Falk Corporation, Milwaukee, with the Foundrymen of Wisconsin, have worked out a satisfactory code and set up a Dust Laboratory in charge of E. G. Meiter, recently the chief dust expert, U. S. Bureau of Mines. H. K. Pancoast of the University of Pennsylvania is their consultant.

The Industrial Management Council of Rochester Chamber of Commerce, A. E. Crockett, manager, has a laboratory equipped to make dust counts and X-ray examinations.

The literature on silicosis can best be found in medical libraries. The books and reports on this subject should be studied. Dust counts should be made and the most approved methods in most general use for removing dust hazards should be installed. The following references show how widespread and how long silicosis has been an industrial problem.

Pneumoconiosis (silicosis), a röntgenological Study with Notes on Pathology, by H. K. Pancoast and E. P. Pendergrass; published by Paul B. Hoeber, Inc., New York.

"Pulmonary Disease among Miners of Joplin District, Missouri, and Its Relation to Rock Dust in Mines," by A. J. Lanza and Edwin Higgins. U. S. Bureau of Mines, *Tech. Paper*, No. 105 (1915); price 5¢.

"Miner's Consumption," by A. J. Lanza. *U. S. Public Health Bull.*, No. 85 (1917).

"Dust Hazard in Abrasive Industry," by C. Winslow, L. Greenberg, and D. Greenberg. *U. S. Public Health Rept.*, No. 34 (1919).

U. S. Public Health Rept., Vol. 35, No. 41, by L. Greenberg.

Report by A. Mavrogordato. South African Inst. Medical Research, No. 15 (1922).

Report on the Grinding of Metals and Cleaning of Castings with Special Reference to Effects of Dust Inhalation upon the Workers, by E. L. Macklin and E. L. Middleton. H. M. Stationery Office, 1923.

"The Dusted Lung with Special Reference to the Inhalation of Silica Dust (SiO_2) and Its Relation to Pulmonary Tuberculosis," by B. S. Nicholson. *Jour. Industrial Hygiene*, Vol. 5 (1923) (55 Van Dyke St., Boston, Mass.).

Public Health Bull., No. 176.

Jour. Ind. Hyg., Vol. 7, No. 1., by H. R. M. Landis.

"Silicosis," by E. R. Hayhurst. *Jour. Ind. Hyg.*, Vol. 6, No. 6 (1924).

"Dust Hazard in the Abrasive Industry," by W. Irving Clark. *Jour. Ind. Hyg.*, Vol. 7, No. 8 (Aug., 1925); Vol. 11, No. 3 (1929).

Report on Investigation of the Pulmonary Condition of Mine Employees of Western Australia, by W. T. Nelson. Commonwealth of Australia, Dept. of Health, Ser. Pub. No. 5, Div. Industrial Hygiene, 1927.

Report on Work of Miners Phthisis Medical Bureau, by L. G. Irvine, Govt. Printing and Stationery Office, Pretoria, Union of South Africa, 1929.

International Labor Office, Records of the International Conference at Johannesburg, 1930; Studies and Reports, Ser. F (Industrial Hygiene), No. 13, Geneva, 1930.

"Silicosis and Tuberculosis among Miners of the Tri-State District of Oklahoma, Kansas, and Missouri," by R. R. Sayers, F. V. Meriwether, A. J. Lanza, and W. W. Adams. U. S. Bur. Mines, *Tech. Paper*, No. 545 (1933); price 5¢.

Dust Hazards and Prevention of Injury from the Same, by W. Irving Clark. Norton Co., Worcester, Mass. (private publication); paper read at a meeting of Government Officials in Industry, Boston, May 31, 1931.

"Do Lawsuits Levy Tribute? Legal Expert Points to Dangers of Common Law Damage Cases Based on Alleged Silicosis." *Foundry*, **60** [12], 23–56 (1932). (Penton Publishing Co., Cleveland.)

"Wisconsin Foundries Coöperate. Group Action Affords Protection and Points to Preventive Procedure in Solving Silicosis Problems," by E. O. Jones, Belle City Malleable Iron Co. *Foundry*, Vol. 61, No. 1 (1933).

"Good Housekeeping at Falks: Remove Dust Accumulation, Isolate Sources, and Provide Contrasts to Hold Standards," by V. J. Hydar, Falk Corp., Milwaukee, Wis. *Foundry*, Vol. 61, Nos. 2 and 3 (1933).

IN THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE THIRD CIRCUIT NO. 4861; TERM 1932

Pennsylvania Pulverizing Company, Co-defendant-Appellant, *vs.* Eldred C. Butler, Plaintiff-Appellee

Appeal from the District Court of the United States for the District of New Jersey. Opinion filed September 29, 1932 before Buffington, Wooley, and Thompson, *Circuit Judges*.

Wooley, *Circuit Judge*.

Pennsylvania Pulverizing Company is engaged in the business of grading and pulverizing sand for commercial purposes. The process, shortly stated, is to dig from a pit free silica sand such as is found on beaches by the sea. A portion of this raw produce is sold for building purposes and for use by railroad locomotives and foundries. For practically all other purposes the sand must be converted into its relatively pure crystalline form; therefore the balance is washed over concentrating tables to eliminate fine particles and impurities. The residue, now pure silica but with quartz particles of different sizes, is, after drying, hoisted in conveyer buckets to the top of an 80-foot tower and dropped on a vibrating screen of a certain mesh. Sand grains which are too large to go through the screen are carried off as tailings; the sand which goes through the first screen but does not go through screens of progressively finer mesh positioned below is sold mainly for the manufacture of glass. That which is not so disposed of is put through airtight revolving pebble mills and ground to a powder which, after sale, usually is used for the abrading element in many commercial products, among them tooth paste. Although much of the sand movement is in airtight passages, the operations as a whole are very dusty.

Eldred C. Butler had for nearly two years been an employee of the Pulverizing Company. He claimed that, while in its service, he contracted a disease, or perhaps because of uncertainty of the medical profession the ailment may be called a condition, known as silicosis. However termed, it is serious. It arises from exposure to silica dust and is incurable. The symptoms are shortness of breath, limitation of lung and chest expansion, loss of weight, and a dry cough. When silica dust is inhaled, the particles under 10 microns in diameter (a micron is $^1/_{25,000}$ inch) enter the tiny lung sacs and stay there, setting up an over-production of fibrosis or scar tissue. These small dust particles do the mischief; the larger or ordinary dust particles are discharged by the respiratory organs.

Stating the duties which in law a master owes his servant and averring that by breach thereof he had, on inhaling uncontrolled silica dust, sustained serious injuries, Butler brought this suit. He specified, very satisfactorily from a pleader's standpoint, four grounds of negligence which we shall state and discuss presently. From a judgment in his favor, the defendant took this appeal.

We must, preliminarily, dissipate the atmosphere which beclouds the real issue of the case in order to bring them sharply into view. The plaintiff, at the argument, laid great stress upon the dusty character of the industry in which the defendant is engaged, indicating that it is highly dangerous in that it involves serious and somewhat insidious hazards to health, and implying, without asserting, that the industry is unlawful. Assuming for present purposes that the industry is a dangerous one, yet, even so, there is no evidence that it is unlawful. Like many industries whose products are pulverized materials, such as cement, lime, gypsum, feldspar, barytes, talcum, snuff, and medicinal and dental bases which affect the health or comfort of their operatives, the product of the industry in which the defendant is engaged is impalpable powder—indeed, its product is dust, the manufacture of which is not *per se* unlawful and the operations are not *per se* negligent. Therefore, whether this is an industry which, on public or humane grounds, should be abolished is a matter not to be determined by the judicial department of the government and is not here in issue.

There are many questions raised on this appeal. The main and perhaps controlling one is whether the trial court erred in refusing the defendant's motion for a directed verdict for one or more of the reasons there alleged. The first reason was that there is no proof of any one of the four grounds of negligence on the part of the defendant which the plaintiff alleged in his complaint and on which he built his case.

The first ground of negligence charged, and assailed as not proved, is (*a*), that the defendant failed "to use reasonable care to provide the plaintiff with a reasonably safe place to work."

The duty of a master in that regard is, as matter of law, so well established that it does not call for discussion. Burhs *v.* Del. & Atl. Tele. Co., 70 N.J.L. 745. This averment, however, is general and may be passed by in view of the particular averment to the same effect and to which all evidence on the point was directed, that (*c*) the defendant, in making the place safe for the plaintiff to work, failed "to use reasonable care to provide a proper ventilating system in its plants."

The Pulverizing Company had been in the business of pulverizing sand since 1906. In 1929 it built a new plant at Toms River, New Jersey. Before completing construction, its president, who had long been conversant with the industry and its objectionable operative features, took certain measures bearing on a master's duty to protect his servants by exercise of reasonable care, to which he testified as follows:

"When we were drawing the plans for this plant . . . at Toms River, both myself and several of our engineers visited a great many dusty plants all over the eastern part of the U. S. By that I mean east of the Mississippi River. I went as far as St. Louis to see one. I inspected plants in Cleveland and Rochester, in Keene, N. H., down at Erwin and Sweet Water, Tenn., all plants I could find where they were handling dusty material, in order to benefit by all of their experience in securing the very best dust-collecting and -ventilating systems it was possible to secure.

"Then after we had done that and found out what was used elsewhere, coupled with our own experience in other plants, we submitted the preliminary plans of this plant at Toms River to the Cleveland Blower Company and asked them to design and construct the very best dust-collecting and -ventilating system that was possible to get for that plant at Toms River. They submitted plans for that dust-collecting and -ventilating system. We adopted those plans and instructed them to go ahead. Those plans were submitted to the Department of Labor at Trenton, Department of Labor of the State of New Jersey, and that ventilating- and dust-collecting system covered the entire plant, where there was any dust at all. It did not apply to parts of the plant where there was no dust.

"We selected the Northern Blower Company because we found they had done a great deal of the work outfitting other plants in the other dusty trades, not only the silica business but in a great many others, lime and gypsum, feldspar, etc. We found they had a great deal of experience and we believed their system was the best system we could obtain for that purpose.

"We installed that completely; the cost of it was pretty heavy, but we installed it as planned, at the start, before the mill was finished. That was fully installed with the working of the mill."

Professor Drinker, Associate Professor of Hygiene at Harvard University, School

of Public Health, testifying with reference to the defendant's ventilating system, said, in answer to a question whether or not it was standard in that type of plant: "There is not any real standard. It is fully in keeping with, if not better, than the standards in other plants that I saw or in grinding plants in general."

M. E. Eiben, President of the Northern Blower Company, Cleveland, Ohio, which designed and installed dust-collecting systems all over this country and in foreign countries; indeed, he had made dust collecting his life's work and had done nothing else. He further testified that the dust-collecting machine in use at Toms River is of the type approved by the State of New York and is accompanied by certain guarantees as to clean discharge of air. When asked whether or not the equipment which his concern had installed compares in efficiency with dust-arresting and dust-collecting devices in other silica plants, he answered that it does. To the question: "And is it abreast of the art?" He replied: "It is up to the minute."

Ellwood Driver, Inspector of the New Jersey Labor Department, testified that in December, 1930, he visited the plant twice and found it "in excellent condition" and on examining the ventilating apparatus, he found it "fine . . . good, very good."

Doctor Andrew F. McBride, former Commissioner of Labor of the State of New Jersey, visited the plant in May, 1931. Though after the event, his testimony was admitted on a promise by the counsel to connect it up. It was to the effect that, as to the condition of the plant with respect to safety appliances and precautions taken for health of the workers, he "found it to be in a very good condition."

John Roach, Deputy Commissioner of Labor of the State of New Jersey, examined the plant in December, 1930, and January, 1931. In reply to a question with reference to safety appliances, both ventilators and respirators, he said: "I found it satisfactory."

Morton I. Dorfan, Manager of the Dust-Collecting Division of the Pangborn Corporation, a member of the National Safety Council of the Sandblast Hazard Committee of that organization, visited the plant in May, 1931. On being asked to tell the court and jury the condition and efficiency of the ventilating system which he found there in operation, he answered, without objection: "I would consider that ventilating system, even though it has been built by a competitor of ours, as equal and possibly superior to many I have seen in plants, handling, first of all, the same kind of dust, and other siliceous dusts."

Doctor Henry H. Kessler, Director of the State Occupational Disease Clinic of New Jersey, speaking with reference to the equipment for ventilation at the Toms River plant, said: "From my general knowledge of plants having dust hazards, I believe the equipment used was satisfactory for the purpose."

Opposed to this testimony for the defendant on the issue of negligence in ventilation, the plaintiff proceeded to prove negligence in this particular by testimony that his work about the plant was in sweeping up the dust, in bagging sand, sometimes directly from the end of the mill, in burlap, or tightly woven cloth bags which sometimes would burst, in working at the drier, but mainly (for about a year) in working in the screen tower keeping the vibrating screen from clogging by means of a compressed air gun and a steel brush. Butler testified that to the screen at the top of the tower there ascended through an open shaft a belt conveyer with uncovered buckets of sand, and that, though from buckets and screen the dust was very bad, there was no ventilating system except windows which he was ordered "to keep shut, to keep the sand from blowing off from the belt, going to the screen." And, finally, that Driver and Roach, officials of the New Jersey Labor Department, recommended the use of paper bags in place of fabric bags.

On this evidence the court submitted the case and allowed the jury to find whether the defendant was negligent, because of lack of reasonable care, in failing to install and maintain a proper ventilating system in its plant.

Whether on this evidence the court erred in submitting the case to the jury is a question to be determined not by weighing the evidence for the plaintiff against the evidence for the defendant, since that is not the function of an appellate court, but by subjecting the evidence for the plaintiff alone to the test of several well-established rules of law relating to the quality of proof in general and to the character of proof required in this particular kind of a negligence case. The first, which is negative, is that in federal courts the scintilla rule no longer exists; the second, that evidence to be controlling should be substantial enough, if submitted, to sustain an affirmative finding by the jury, Evans *v.* Ely, 13 Fed. (2d) 62, 64; and to be validly submitted it must be "something of substance and relevant consequence, and not vague, uncertain, or irrelevant matter not carrying the quality of proof." Minahan *v.* Grand Trunk Railway Company, 138 Fed. 37.

The plaintiff's evidence of the defendant's ventilating system might show negligence were it permissible to infer negligence from the fact of the plaintiff's injury, or it might show a spark of evidence of negligence from the fact that the windows in the tower were kept closed. But without more to prove that keeping the windows closed need not, in an orderly manufacturing process, have been done or should not, for the plaintiff's protection, have been done, that evidence, standing alone, is not enough to submit to the jury, or, if submitted, is not enough to sustain an affirmative finding of negligence. It left uncertain and unproved, and therefore left the jury of conjecture, whether the defendant did something it should not have done or failed to do something it should have done. Keeping in mind that the plaintiff charges the defendant with negligence, not in making too much dust or in making more dust than a properly organized plant properly operated would make, but in failing to use reasonable care to provide a proper ventilating system to control the dust it did make, proof of much dust at a particular place without proof that the defendant could and therefore should have provided efficient means to overcome it is not substantial enough to be controlling on the averment that it was negligent in failing "to use reasonable care to provide a proper ventilating system."

Moreover, the plaintiff's evidence of negligence in ventilation must respond to the test of another rule affecting a master's duty to his servant, which is that he is required only to use "reasonable care" in selecting instrumentalities for his protection. On this rule, now established almost everywhere, this court said in Haines *v.* Spencer, 167 Fed. 266,271;

"The employer is not an insurer, and the duty imposed upon him is not to furnish the safest or newest and best machines and appliances, but only to exercise due care to provide those which are reasonably free from danger. (Citations.) And the rule as to this is the usage of the business, negligence not being imputable where the machine in question is that which is generally employed." (Citation.) Tompkins *v.* Machine Company, 70 N.J.L. 330; Stapleton *v.* Reading Co. 27 Fed. (2d) 242.

The court, continuing on the question as to how this is to be proved, said:

"It may be that, for the purpose of comparison, it would be admissible, in order to aid the jury in determining what is reasonably safe, to put other machines in evidence which are in common and ordinary use in similar establishment." (Citing authorities for and against this procedure.)

Without expressing ourselves upon the procedural part of the rule, it should be noted that, whatever it be, the plaintiff in this case, though recognizing the rule of "reasonable care," assailed the defendant's system of ventilation (as involving negligence) by proof of dust in large quantities here and there, not by proof of other mechanism or means known to the industry or to the science of hygiene by which the dust could be controlled more effectively. So the plaintiff's evidence not only failed to prove (by showing better instrumentalities) that the defendant's ventilating system might have been better but, for the same reason, it stopped short of proving it was not such a system as by the exercise of reasonable care could, and should, have been furnished. Failing affirmatively to meet this test and failing also to contradict the defendant's evidence as to its exercise of reasonable care in studying the dust problem, endeavoring to solve it, and providing not only "apparatus in common use" but "apparatus of superior quality," purchased from a reputable and experienced manufacturer, Bauman *v.* Condin 75 N.J.L. 193, 195; 76 N.J.L. 575, the plaintiff's evidence was insubstantial within the rule of Evans *vs.* Ely, Supra, and offended the final rule (and test) which forbids the submission of such uncertain evidence from which the jury was permitted to guess and decide, against the practice of the industry and knowledge of the art, what is a proper or improper ventilating system in the industry. Del. L. & W. R.R. Co. *vs.* Koske, 270 U.S. 7; Kilpatrick *vs.* Choctaw O. & G. R. Co., 121 Fed. 11; Canadian Northern Railway Co. *vs.* Walker, 172 Fed. 346; B. & O. R. R. Co. *vs.* Newell, 196 Fed. 866; Lehigh Valley R. R. Co. *vs.* Passinier, 4 Fed. (2d) 46.

Another reason in the defendant's motion for a directed verdict (still under consideration) is that the plaintiff did not prove its second averment of negligence in that the defendant (*b*) failed "to use reasonable care to provide the plaintiff with proper masks or other appliances or safeguards in said work."

The president of the defendant company testified that before starting up the Toms River plant, he gave a great deal of study to masks and particularly to the types made by the Willson Company. He visited concerns that purchased these masks, saw them in use in dusty plants, and then adopted them.

Doctor Andrew F. McBride, Commissioner of Labor of the State of New Jersey,

testified that the masks with which the defendant supplied its servants "were practical and efficient."

John Roach, Deputy Commissioner of Labor of the State of New Jersey, testified that masks of the type in the defendant's plant had been approved by his Department of Labor for use in this type of work.

Harry F. Speer, President of the New Jersey Pulverizing Company, a competitor of the defendant, testified, as did one of the witnesses for the plaintiff, that "air-line masks," another type, were still in an experimental stage. He said that the masks used by the defendant were in his judgment, after thirty years' experience in the business, better suited for the purpose.

Doctor Fred Willson, President of the Willson Products Company, Reading, Pa., a member of the Sandblast Committee of the National Safety Council and of the Advisory Committee of the Bureau of Standards, said with respect to the defendant's masks, that they are used generally in dusty trades and are "for all practical shop purposes fully protective." Speaking with reference to the air-line or direct-pressure masks, he testified: "To the best of my knowledge it had not been used and I would not have recommended it."

Professor Drinker of the School of Public Health, Harvard University, said that the Willson sponge mask used by the defendant is "a little ahead of the standard" and that the air-line mask, which is still in an experimental stage, is "just an unsatisfactory piece of equipment for that work, ... is distinctly impractical . . . . they have not been successful."

The testimony for the plaintiff on the question of masks shows that, entering the defendant's employ in June, 1929, and leaving it in February, 1931, he was not given a mask for three months after his employment. He was then given masks which were in common use throughout the plant and wore them the remainder of his stay, but contends they were defective because dust particles seeped through the sides and through the sponge, and because the mask can only operate properly with a moist sponge and the sponge could not be kept wet by workmen at the top of the screen tower as the nearest available water was kept at the bottom of the tower. Other witnesses for the plaintiff testified to the same effect; although none contradicted the testimony for the defendant as to its care and caution in selecting and providing masks. The drift of the plaintiff's testimony was that the defendant should have furnished a better mask, perhaps the air-line mask, although the testimony for both plaintiff and defendant was that such a mask, being still in the experimental stage, had not gone into general use in the industry.

Notwithstanding there is testimony for the defendant that masks were supplied all men at the opening of the Toms River plant and continuously thereafter, we shall accept as true the plaintiff's statement that he was not supplied with one until three months after starting work. But we shall regard this statement, in view of the plaintiff's failure even to intimate that disease developed during that period, as not bearing on the question because, according to the evidence, the disease of silicosis occurs only after exposure to silica for a long time, and, that assuming it later developed, it could not have been set up in the first three months of the twenty months of the plaintiff's employment without being discovered by him before the sixteenth month.

In August, 1930, fourteen months after going to work, the plaintiff complained that his mask did not fit and was furnished another. He testified that in October, 1930, sixteen months after going to work, he felt pains in his chest and in November felt pretty bad. Several weeks before the end of his employment, he requested that he be furnished with an air-line mask in place of the sponge mask which he had been using. The superintendent promised to get him one. Such a mask was obtained and given to the plaintiff but, because its valve clogged repeatedly, requiring the man to take off the mask and make adjustments in the dust, it was not satisfactory and could not be adapted to the defendant's plant.

The evidence for the plaintiff as to the defendant's alleged negligence in supplying the kind of masks it did and in not supplying better ones shows the same infirmities as the plaintiff's evidence of negligence in the ventilating system previously discussed. It is controlled by the same rules of law, is subject to substantially the same observations we there made and is, we hold, equally insubstantial. It follows it was error for the trial court to submit this evidence and permit the jury to find from it that the defendant was negligent when it does not show how better, or how else, it could perform its duty of exercising reasonable care in the circumstances.

The fourth and final ground of negligence which the plaintiff charged to the defen-

dant was (*d*) its failure "to give the plaintiff proper warning, information, and knowledge of the dangerous character of its work with the sand silica dust."

There is of course no question of a master's duty in this regard. He must instruct and warn his servant as to dangers of which he knows or ought to know, and of which he knows or ought to know the servant is, from the nature of things, ignorant. Ramsay *v.* Raritan Copper Works, 78 N.J.L. 474; Rhobobsky. *v.* N. J. Worsted Spinning Company, 76 N.J.L. 542.

It is not clear that the defendant knew precisely what the effect of long exposure to silica dust would be, nor is it at all certain that it is chargeable with pathological knowledge of the subject in view of the uncertainty with respect to the matter prevailing in the medical profession.

One doctor testified: "There is no knowledge anywhere in the country today of how much exposure is necessary to produce silicosis. Nor is there any accepted standard by which one can tell whether a given set of conditions will or will not produce silicosis."

Another doctor testified: "There is no expert on silicosis because it is a state of disease that nobody, even those who claim to have experience in the matter, is able at the present time to determine what silicosis is, except they know it is fibrosis of the lung. Beyond fibrosis of the lung they do not know what it is."

At the trial the medical experts were divided into two groups on the question whether the plaintiff has silicosis at all.

Yet, unquestionably, the defendant master should have known that there is some danger from constant exposure to dust from ground quartz. Evidently, it did know it, and it realized its duty to guard against that danger by providing ventilators and respirators and then by warning its servants. The defendant, speaking through its president, said:

"We always told every man who worked in the mill the danger of the dust. We have always given without expense to them the most effective mask we could find for that purpose. We have told them they must wear these masks at all times there in the mill on duty. We have shown them how to wear masks, how to adjust them, how to clean the sponges. We have provided facilities for cleaning the sponges and we have seen that they do wear the masks. . . . The supply of these masks was kept in an accessible place and the employee was permitted to help himself to them."

The foreman of the plant testified that the men uniformly were told that dust was injurious to health and they should wear masks and try to prevent it.

Opposed to this the plaintiff testified that he was not so warned. Yet the fact is, he was supplied with masks and wore them, and the fact remains, not disputed, that the defendant supplied masks generally and instructed the men in their use. The defendant's act of supplying the plaintiff with masks and the plaintiff's observation that it supplied his fellow-workers with them are warnings in themselves for, obviously, a master would not have required his servants to undergo the inconvenience of wearing masks and, indeed, the servants would have refused to wear them, unless there were some reason for their use. We think the real trouble on this issue of warning is that the plaintiff complains that the defendant did not warn him of the pathological effect of inhaling silica dust. This may be true but it is not certain that the defendant knew or should have known it in time reasonably to warn the plaintiff. We find no evidence on the part of the plaintiff charging the defendant with knowledge of the disease. Nor is there evidence that the disease normally follows contact with silica dust, or what conditions will produce the disease, or how long it takes to develop, or, when developed, what precisely is its character. We find it difficult to believe that an employee of normal intelligence working in dust has to be told that inhaling dust of any kind in large quantities is injurious for, obviously, when he is handed a mask and put to work with other men wearing masks in a place equipped with artificial ventilators, that is a plain enough warning that dust is deleterious. We can not find, on the plaintiff's showing, substantial evidence that the defendant failed in its duty to give the plaintiff adequate warning of the dangerous character of his occupation.

We are constrained to hold that the learned trial court erred in submitting the case to the jury and in refusing to direct a verdict for the defendant on the ground that the plaintiff had failed to prove by substantial evidence any one of the four allegations of negligence on which he rested his case.

As the decision on this question is dispositive of the case, we shall, without reviewing the other questions, decree that the judgment below be reversed, a *venire de novo* issue, and that any further proceedings shall be conformable with this opinion.

A true copy: Teste: Clerk of the United States Circuit Court of Appeals for the Third Circuit.

PAPERS AND DISCUSSIONS

PREPARATION OF THIN SECTIONS OF FRIABLE MATERIAL*

By Thomas H. Hite

I. Introduction

A method of making thin sections, using Canada balsam as a cement, is satisfactorily applied to a variety of friable materials. Equipment available in most laboratories is usually satisfactory. If hydrous minerals are to be examined, temperatures not in excess of 100°C may be used. Processes described by Johannsen,[1] Ross,[2] and Leggette,[3] have been freely drawn on. The method described below was developed largely in 1928 in the preparation of thin sections of clays at the University of Idaho. By this method the process of grinding eliminates much of the plucking away of softer minerals and produces thin sections in which the various minerals maintain nearly uniform thicknesses.

II. General Features

Permeability of material depends largely on the absorptive properties of minerals as well as the porosity of the specimen and the viscosity of the cementing agent. Impregnation of some specimens, especially if quite porous, can be made in the usual manner by cooking the chip for a few minutes to several hours in a vessel containing Canada balsam, or by placing balsam on the inverted chip. The addition of a thinner such as xylene improves and facilitates impregnation at lower temperatures but necessitates longer cooking. According to Ross,[4] temperatures from 150 to 170°C may be safely used in the preparation of most clays containing hydrous minerals without appreciably altering their optical properties. Leggette[5] says, however, if hydrous minerals are to be examined, the temperature applied should not exceed 100°C. Either limit may be complied with. Much time may be saved by the use of higher temperatures in the preparation of thin sections of many minerals. An electric oven which can be ventilated is most satisfactory as it speeds up the operation, but an electric hot plate is adequate. The following procedure is particularly applied to making thin sections of friable specimens of residual and transported clay containing, in addition, hard grains of quartz, feldspar, and accessory minerals. Some of the steps may be omitted in making sections of nearly uniform, soft material. If the minerals are such that water can be used in the grinding processes, rather than oil, much time is saved by its use.

III. Procedure

Material to be used should either be air dried or dried in an oven at a temperature slightly less than the maximum allowable for the minerals involved. Trim a flat or even surface adjacent to the part of the chip desired for the thin section. In some instances, however, a fairly regular, broken surface is the best that can be obtained. It is advisable to make another flat surface opposite the trimmed surface as it may be necessary to invert the specimen for the final impregnation.

Impregnation of certain specimens may be made by heating them in raw or partly cooked Canada balsam, when about 200°C can be applied. Thinned balsam is generally

* Received December 17, 1932.

[1] A. Johannsen, Manual of Petrographic Methods. McGraw-Hill Book Co. (1914).

[2] C. S. Ross, "Methods of Preparation of Sedimentary Materials for Study," *Econ. Geol.*, **21**, 460–68 (1926).

[3] Max Leggette, "Thin Sections of Friable Rock," *Jour. Geol.*, **36**, 549–57 (1928).

[4] C. S. Ross, *op. cit.*, p. 462.

[5] Max Leggette, *op. cit.*, p. 554.

used when hydrous minerals are to be preserved, because it saturates the chip more extensively and because very soft specimens are given sufficient body to be handled readily. Again, other chips may be merely soaked with thinner previous to placing them in the balsam, if only a partial but rapid impregnation is required. The flattened surface of the chip is placed in a vessel containing about 1/4 inch of balsam. When raw balsam is used alone it is advisable to cover the container partly during the earlier part of the cooking in order to keep the surface of the balsam thin. Cooking should continue until the balsam penetrating the chips will harden on cooling. Chips having enough body to permit handling may be inverted and given an additional cooking to allow the thick balsam adhering to the specimen to penetrate deeper. To remove excess balsam, either scrape it off or lightly press the impregnated face against paper laid over a flat surface.

The flattened surface to be used for mounting on the object glass is obtained by first grinding in the customary manner on a lap wheel with standard sizes of silicon carbide and transformer oil or light medicinal oil similar to Nujol. Coarse and medium silicon carbide paper on which oil and loose silicon carbide is freely applied also is satisfactory. Shallow penetration of balsam and extensive grinding may expose rough or light colored areas which have received only partial impregnation. Another short cooking in balsam may be necessary, but in most instances stick balsam dissolved in xylene is placed on the inverted face of the chip and allowed to cook for an hour or more. Excess material is removed by grinding on No. 280 silicon carbide paper upon which a generous amount of light oil is placed. The surface is finished on No. 400 paper, or finer if necessary, and during the final stage of grinding merely enough oil is used to show on the silicon carbide paper. The finer sizes of silicon carbide paper are stretched over plate glass. Apply an excess of clean oil to the prepared surface, rub it lightly with the finger tip to loosen adhering foreign material, and wipe the surface clean with a soft cloth or filter paper. This surface is ready for cementing onto the object glass.

The chip is mounted on an object glass on which Canada balsam has been applied and cooked much in the usual manner. When the balsam is cooked slightly less than ordinarily used for mounting, the prepared surface is warmed (not melting the surface) and the chip is applied by pressing it firmly on the object glass for one or two seconds before it is removed from the hot plate. Quickly transfer the specimen to a flat surface, press the chip down gently, and allow it to cool. Should the chip lack sufficient body to permit moderate pressure against the object glass, it may be enclosed in plaster of Paris.

The chip is then ground to a thickness of 1 or 2 mm. in much the same manner as previously described for the coarse and medium grinding of the specimen for mounting on the object glass. Grinding is continued with No. 150 or 200 silicon carbide scattered on No. 180 silicon carbide paper until the slice is about 3/4 mm. thick, then only No. 180 paper and oil are used. Care should be exercised as the section thins not to use silicon carbide which is too coarse, because the sharp, severe blows tend to break the chip loose from the object glass. No. 280 silicon carbide paper is then used, followed by No. 400 or finer silicon carbide paper. It is necessary in the final stages of grinding to keep the surface of the abrasive paper free of coarse particles.

The final step in the preparation of the thin section is to mount the cover glass using stick balsam dissolved in xylene. Special care must be exercised not to cause the mineral slice to separate and flow.

IV. General Suggestions

The lack of uniformity of thin sections containing both hard and soft minerals is noticeable when the finishing of surfaces is made by grinding on some object upon which loose abrasive is placed in water or oil, as the uneven piling up of the grains plucks out the softer minerals. Finishing on moistened "wet or dry" silicon carbide paper practically eliminates this undesirable feature.

As the balsam in the mineral slice is generally inclined to be overcooked it is best to undercook slightly the balsam cement first applied to the object glass. Should the balsam seem brittle and inclined to break loose during the final grinding it can be made softer by warming the fingers which are pressed on the object glass and by warming the plate glass. If the balsam cement is undercooked and fine particles adhere to it, a piece of glass or cork may be glued to the back of the object glass or a rubber vacuum (suction) cup may be used.

Oil should not be left on the chip for any length of time as it softens the balsam. Transformer oil, separator oil, a good grade of typewriter oil, or spindle oil is quite satisfactory for grinding on the lap wheel.

Balsam, dirt, and oil may be removed from the used abrasive paper with benzene and the paper used repeatedly.

Saturation of only part of the chip with balsam is often desirable as it facilitates grinding away excess portions after the chip is cemented to the object glass.

Emery may be used instead of silicon carbide and other solvents than xylene are in common usage.

The many types of firable material will necessitate variations in technique and materials used.

Acknowledgment The writer wishes to express his appreciation for the use of laboratory facilities and materials of the School of Mines of the University of Idaho, Moscow, Idaho.

UNIVERSITY OF IDAHO
MOSCOW, IDAHO

MANUFACTURING CONTROL OF DRY-PRESSED PORCELAIN*

By Frank Cermak and L. E. Thiess

ABSTRACT

The methods used for manufacturing control of raw materials and manufacturing processes are described. The continuous filtering machine gives greater uniformity and other advantages to a dry-pressed porcelain body.

I. Introduction

The ever-increasing demands for better quality, greater uniformity, and more accurate dimensions, together with lower prices, command the manufacturer of electrical porcelain to make use of improved and controlled methods of manufacture.

Dry-process electrical porcelain has been manufactured in our plant for nearly forty years. The variety of such porcelain parts is very great. Some smaller pieces weigh less than one gram while others weigh as much as thirty pounds. Some of the larger types are shown in Fig. 1.

II. Control of Raw Materials

The manufacture of ceramic ware begins with the raw materials, which are supplied in most instances as unrefined, natural products, such as clays, feldspar, and flint. After one raw material has been accepted for production it is important that the supply be as uniform as may be expected of such natural materials.

For controlling purposes, a small amount of each approved material is put aside in containers, so that at any time a comparison between the original sample and the last shipment may be made.

For dry-process porcelain body an orthoclase feldspar is used.

The specifications for flint call for a silica content of not less than 99.5%.

Every carload of feldspar and flint is tested for fineness of grain before being released for unloading in the bins. The specified total allowance on 325-mesh screen for feldspar is 10.00% and for flint, 12.00%. A fusion test of feldspar is made on each carload, and the method is the same as has been described by Dubois.[1]

There are no formal purchasing specifications for china clays or ball clays, but these materials are tested periodically, and tests such as modulus of rupture, shrinkage, and porosity determinations at different firing temperatures are made in conformity with the standard specifications of the American Ceramic Society.[2] Such detailed laboratory tests are always required for new materials which are to substitute old materials in the regular body mix.

Unless clays arrive in dry condition in the factory, moisture determinations are made twice a week and the laboratory informs the sliphouse foreman how much compensation to the batch weights must be made for water.

III. Body Preparation

The present method of dry-process body preparation constitutes a great

* Presented at the Annual Meeting, American Ceramic Society, Pittsburgh, Pa., February, 1933 (White Wares Division). Received December 12, 1932.

[1] H. B. DuBois, *Jour. Amer. Ceram Soc.*, **15** [2], 144–48 (1932).

[2] Standard Specifications, *ibid.*, June (1928).

change over that of a few years ago. It would require too much space to describe here the details of mixing, etc., and therefore the old and new methods are hereby given graphically on the flow chart (Fig. 2).

FIG. 1.—Heavy press for porcelain insulators.

The advantages of the new method may be summarized as follows: (*a*) a more uniform porcelain body, as no segregation of the coarser particles, such as frequently occur in filter-press cakes, is possible; (*b*) instead of a wet, heavy filter cake the clay is received in small broken-up layers, about $^1/_{16}$ inch thick, with an almost uniform moisture content; the drying of the filter cakes, the crushing, re-wetting, and aging before the process of pulverization, are entirely eliminated; (*c*) a more uniform drying and firing shrinkage is obtained and fewer losses in oversized or undersized porcelain parts occur; and (*d*) a saving of labor.

IV. Control of Manufacturing Processes

Such control can successfully be carried out only by the coöperation of laboratory and shop foremen. The methods employed are herewith given as follows:

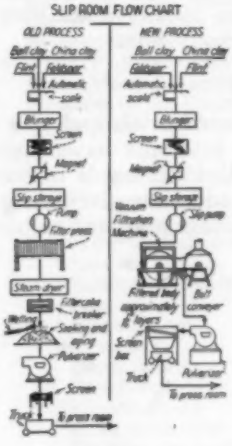


FIG. 2.

(1) Moisture Control The amount of moisture in the pulverized clay has a great influence upon the shrinkage, density, and appearance of the pressed porcelain part.

Spurrier[3] has shown the effect of moisture content upon the shrinkage of dry-process porcelain. This laboratory makes regular checks upon the water content of the pulverized body as it is delivered to the press room. The press foreman is notified at once if the moisture content is below or above the specified limits.

(2) Shrinkage Control Special shrinkage disks (as shown in Fig. 3), approximately $3^1/_2$ inches in diameter by $^3/_4$ inch thick, are pressed daily and dated. These disks are dried, fired, and gaged for fired size. Pyrometric cones are always placed with these trial pieces. Sometimes some of these disks are also used for porosity tests.

(3) Die Wear In order to check the die wear and to eliminate oversized ware, the inspector is supplied with a few pieces of every article which has been pressed during the day. These parts are then put into the next available kiln and the fired dimensions are com-

[3] H. Spurrier, "Investigation of Dust-Pressed Practice as Influencing Finished Sizes and Cracking," *Jour. Amer. Ceram. Soc.*, 5 [11], 798 (1922).

pared with the drawings. In this way irregularities in the dimensions are early detected and great losses avoided.

(4) Electrical and Mechanical Control of Finished Ware

Dielectrical and mechanical tests on standard test specimens, as shown in Fig. 3, are made from time to time in the laboratory. For transverse tests dry-pressed cylinders 7 inches long by $^3/_4$ inches in diameter are used. The electrical test is carried out on $^1/_2$-inch thick disks which are pressed on standard presses. There are also some other tests

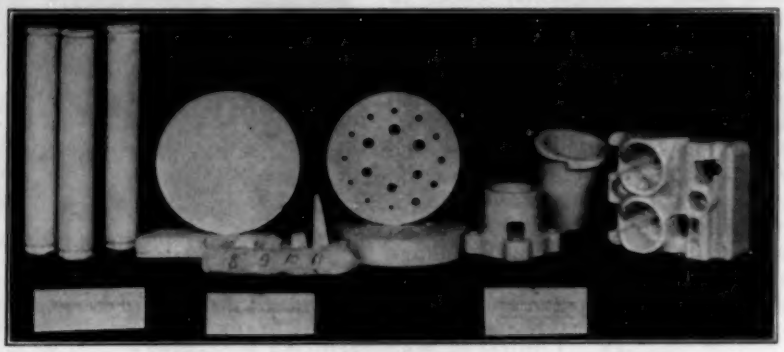


FIG. 3.—Standard test pieces for dry-process porcelain.

provided, such as workability tests (pressing behavior of clay body) and tests for glaze fit and appearance, but the latter are usually made only for a comparative tryout of new raw materials in the body mix.

V. Summary and Conclusions

In outlining the above control methods for ceramic materials and processes for the manufacture of dry-process porcelain, attempts have been made to make use of methods best adapted for individual needs of our plant. These tests are simple and easy to carry out and have given satisfactory results. The new process of dry-pressed porcelain preparation has great merits over the old system.

GENERAL ELECTRIC COMPANY
SCHENECTADY, NEW YORK

ACTIVITIES OF THE SOCIETY

EXCERPTS FROM MINUTES OF THE BOARD OF TRUSTEES MEETINGS, PITTSBURGH, FEBRUARY 12 AND 17, 1933

(1) The minutes of the Washington meetings of the Board, as published, were adopted.[1]

(2) The minutes of the Executive Committee meetings during the year 1932, as published, were adopted.[2]

(3) Voice and vote were unanimously given to elected officers and trustees for the meeting on February 12.

(4) By vote made, seconded, and unanimously adopted, the minutes of the Board of Trustees and of the Executive Committee shall be printed in the *Bulletin* only after submission to the Board or to the Committee, respectively, for decision as to the items to be published.

(5) The appointment of V. V. Kelsey to serve as Chairman at the "Buy American" meeting, Thursday afternoon, February 17, was approved.

(6) The Secretary reported on his activities in the "Buy American" movement in connection with the Society's efforts of long standing to make Americans ceramically conscious, and this was approved.

(7) Report of the Treasurer as contained in the annual statement submitted by Auditor Peters was accepted.[3] On motion of A. Silverman, seconded by R. L. Clare, the Executive Committee and the official staff were given words of appreciation of results obtained, as shown in the annual financial statement.

(8) On motion of F. C. Flint, seconded by J. M. McKinley, hearty appreciation was expressed to the Publications Committee for the high quality of the *Journal*, the economy effected in publication, the new cover design, etc., which marked the advances in the year 1932.

(9) The committee reports were read by title and accepted for publication. These appeared in the April *Bulletin*.

(10) The twenty-one suggestions for places of holding in the 1934 Meeting were considered in great detail, and on vote of W. K. McAfee, seconded by J. M. McKinley, the Secretary was instructed to negotiate with Columbus and Cincinnati, Columbus having received the first and Cincinnati the second choice.

(11) Resolutions were proposed for presentation to Tulane University and the New Orleans Chamber of Commerce because of the almost unanimous opinion of the members of the Board that were it not for the economic depression, they would accept the invitation to New Orleans for the 1934 Meeting.

	1932 Budget	1932 Expenditures	Suggested 1933 Budget
Publications	$12,000.00	$13,739.50	$11,000.00
Abstracts	1,600.00	1,331.39	1,200.00
Editorial Expense	1,000.00	1,144.91	1,000.00
Salaries	12,400.00	12,313.25	11,200.00
Secretarial Expense	1,200.00	1,052.71	750.00
Postage	1,600.00	982.24	900.00
Office Rental	960.00	970.00	960.00
Traveling	240.00	204.23	.....
Depreciation	240.00	213.00	240.00
Bad Accounts	200.00	128.98	150.00
Miscellaneous	400.00	227.44	300.00
Annual Meeting	920.00	873.24	900.00
President's Expense	40.00	31.16	250.00
	$32,800.00	$33,212.05	$28,850.00

(12) Considerations presented by the Art Division for reorganization were made by Edmund de Forest Curtis. These were thoroughly discussed by Mr. Curtis and C. L. Sebring. Without vote the Board strongly favored Mr. Curtis' program. The

[1] See *Bull. Amer. Ceram. Soc.* **11** [4], 92 (1932).
[2] See *ibid*, **11** [5], 125; [10], 244 (1932).
[3] See *ibid.*, **12** [2], 52 (1933).

manner in which this developed during the meeting will be made known through the *Bulletin*.

(13) The report of the Budget Committee (Messrs. Flint, McAfee, and McKinley) was presented, and on vote of McKinley, seconded by McAfee, the budget (see p. 141) was adopted. Incidental to the adoption of this budget compliments and appreciation were voted for Secretary Purdy.

(14) The petition for a charter for Pennsylvania State College Student Section was presented by President Poste and the board authorized the granting of this charter.

(15) Request of Dean Major E. Holmes that the Society appoint official delegates to attend the Alfred Ceramic Building dedication on June 12 was presented by President Poste and the President was authorized to appoint delegates.

(16) Ross C. Purdy was reëlected General Secretary to serve for a period of two (2) years.

(17) On motion of McAfee, seconded by Flint, a vote of thanks was authorized to W. Edwin Wells, President of the U. S. Potters Association; Charles F. Goodwin, Secretary, U. S. Potters Association; George Dougherty, President, the American Glassware Manufacturers, Inc.; Charles E. Voitle, Secretary, the American Glassware Manufacturers, Inc.; and James Duffy, President, National Brotherhood of Operative Potters, for their coöperation in making the Thirty-Fifth Annual Meeting of the American Ceramic Society a success.

(18) The following committee chairmen were named:

Executive Committee: J. C. Hostetter, *Chairman*, J. M. McKinley, V. V. Kelsey, and Robert B. Keplinger.

Education:

Research:

Membership: Perry D. Helser.

Data: T. W. Garve.

Geological Survey: W. M. Weigle, *Chairman*, Hewitt Wilson, John W. Whittemore, and J. E. Lamar.

Sections and Divisions: Emerson P. Poste.

Standards: Arthur S. Watts.

Rules: Lawrence E. Barringer.

Publications: Louis Navias, *Chairman*, L. J. Trostel, Milton F. Beecher, R. M. King, and R. C. Purdy.

Management: W. Keith McAfee.

A. A. A. S.: Cullen W. Parmelee.

A. S. T. M.: (Several committees to be appointed.)

Building Conference—Paving Brick: O. W. Renkert.

Federal Specifications Board: O. W. Renkert.

Plumbing Specifications: W. Keith McAfee.

(19) In further consideration of alteration in publication, its lessened cost, and its decrease in advertising income, Secretary Purdy presented a report, which was referred to the Publications Committee.

SAMUEL E. ELDRIDGE

OUR 1934 ANNUAL MEETING

Samuel E. Eldridge is General Chairman of the Cincinnati Committee of the American Ceramic Society in charge of arrangements for the Thirty-Sixth Annual Meeting at the Hotel Netherland Plaza, February 11–16, 1934.

Richard B. Carothers and Macdonald C. Booze are Vice-Chairmen. Dr. F. R. Henry and Glenn Hutt from Dayton, Fred Thompson and Hobart Kraner of Louisville, Fred A. Tobitt of Middletown, J. F. Sheehy of Newport, and Charles H. Burchenal and Stanley G. Burt of Cincinnati are some of the local members who are coöperating.

1933 SUMMER MEETING, AMERICAN CERAMIC SOCIETY AT CENTURY OF PROGRESS EXPOSITION, CHICAGO, ILL., WEEK OF JUNE 25

The engineering societies of America are united in a week's program of interest to engineers during the week which the Exposition authorities have designated as "Engineer's Week."

The proposed program has two objectives: (1) to provide arrangements so that the visiting engineers may see the exhibits of special interest to them under unusually favorable circumstances, and (2) to provide means for bringing before ceramists, and thus before the public, through addresses, demonstrations, or both, some of the high lights of ceramic contributions to man's progress.

On Wednesday, June 28, 1933, the several societies will have a joint program tentatively arranged as follows:

Meet at 9:30 A.M., in a suitable locality, such as the court of the Hall of Science to receive the coat lapel decoration (to identify the delegates throughout the day) and to form in groups to be taken by the guides to the various exhibits as selected; a description of the exhibits to be visited will either be available at this point or will have been received by the members earlier. A suitable number of properly qualified guides will be on hand to take the groups to the points desired.

Each of the exhibits to be visited will put on special programs relating to the exhibitor's work. It is suggested that at the exhibits, in addition to any machinery or equipment demonstration the exhibitor may put on, the highest officials and (or) noted scientists whose work relates to the subject of the exhibit be present and perhaps make brief addresses.

At 12:30 luncheon at the place or places which will later be determined when the restaurant plans are fully developed by the Exposition. Short speeches and (or) science demonstrations.

At 2:30 or 3:00 P.M. resume trips to the exhibits.

7:00 P.M., banquet at the Stevens Hotel. It is hoped that among the guests at the banquet there will be engineer statesmen of several nations, as well as world-renowned scientists and engineers.

For those who may not be able to attend the banquet (hotel seating capacity about 2400) a special lighting display may be provided at the Exposition grounds.

This week of June 25 at the Exposition is to be made more notable by the fact that the American Association for the Advancement of Science will begin its Annual Meeting on Monday, June 19, continuing through to Friday, June 30. Fifty of the most noted scientists of other countries have received special invitations to participate in this meeting of the American Association for the Advancement of Science, many of whom are well known for their scientific contributions of interest to ceramists.

The American Ceramic Society has scheduled its 1933 Summer Meeting at the Century of Progress Exposition during the week of June 25, participating in the engineers' banquet with suitable joint programs with the several engineering societies, as well as with the American Association for the Advancement of Science. This will indeed be a notable occasion.

The personnel of the local committee on arrangements for the American Ceramic Society is as follows:

R. A. Beverley, *Chairman*, 3754 N. Central Park Ave., Chicago
L. I. Shaw, Western Electric Co., Dept. 7434, Hawthorne Sta.
F. L. Steinhoff, Editor, *Brick & Clay Record*, 59 E. Van Buren St.
H. V. Kaeppel, Editor, Industrial Publications, Inc., 59 E. Van Buren St.
D. F. Albery, Northwestern Terra Cotta Co., 2525 Clybourn Ave.
W. C. Lindemann, A. J. Lindemann & Hoverson Co., Milwaukee, Wis.

A. S. T. M. Invitation

A cordial invitation has been extended to the members of the American Ceramic Society to attend the various sessions of the thirty-sixth annual meeting of the American Society for Testing Materials to be held in Chicago during the week of June 26. Attention is called particularly to the Edgar Marburg Lecture to be held on Tuesday afternoon, June 27, at 3:30. The lecturer is Dr. H. J. Gough, Superintendent, Engineering Department, National Physical Laboratory, Teddington, England.

Tentative Summary of Program, Hotel Stevens, June 26–30

(Note: Braces indicate simultaneous sessions)

Monday, June 26

9:30 A.M. { Joint session with American Foundrymen's Assn., symposium on cast iron
Session on rubber, textiles, timber

2:00 P.M. { Session on cast iron, wrought iron, high-temperature metals
Session on paints, coal

8:00 P.M. { Session on reports of administrative committees, Presidential Address, and Medal Award

Tuesday, June 27

9:30 A.M. { Session on steel
Session on clay pipe, refractories, brick

3:30 P.M. { Edgar Marburg Lecture: "Crystalline Structure in Relation to Failure of Metals Especially by Fatigue," by Dr. Herbert John Gough

Wednesday, June 28

Engineers Day
Evening: Combined Banquet, Stevens Hotel

Thursday, June 29

9:30 A.M. { Session on fatigue of metals, testing
Session on road materials, waterproofing materials, petroleum products

2:00 P.M. { Session on corrosion of metals
Open meeting on presentation of data
Session on mortar, masonry materials

Friday, June 30

9:30 A.M. { Session on nonferrous metals, metallography
Session on cement and gypsum

2:00 P.M. { Session on concrete
Joint session with the Econometric Society and A.S.M.E. "Theoretical Economics in Engineering"

8:00 P.M. { Joint session with the Econometric Society and A.S.M.E. "Fundamental Problems of Mutual Interest to Scientific Economists and Engineers"

Report of Meeting of Committee in Charge of the American Ceramic Society Summer Meeting, Chicago Section, April 7, 1933

Those present were R. A. Beverley, *Chairman*, F. E. Hodek, Jr., G. G. Hanson, F. L. Steinhoff, George P. MacKnight, and H. V. Kaeppel.

The Committee decided, in line with Mr. Purdy's suggestion, to have a get-together dinner at the Stevens Hotel, Monday, June 26, at 7 P.M. The price will be $1.50. The speakers are listed tentatively as John C. Hostetter, President of the American Ceramic Society, a Century of Progress official to explain ceramics at the Exposition, and important guests.

Tuesday, June 27, will be Ceramic Day at the Exposition. This is also Porcelain Enamel Day. All those who wish may meet with the enamelers at the Porcelain Enamel Parade at 3 P.M.

An inexpensive program of events and meetings of interest to members of the American Ceramic Society during Engineer's Week will be furnished.

No other meetings will be held unless otherwise directed by the Society.

REPORT OF THE RESEARCH COMMITTEE OF THE ENAMEL DIVISION FOR THE YEAR 1932–1933*

The Research Committee of the Enamel Division has continued its arrangement with Emerson P. Poste during the past year in further work on the blistering of enamels on cast iron. A large amount of additional data have been obtained which are leading to a better understanding of the problem, although it is evident that further work will

* Submitted Feb. 1, 1933.

have to be done before a final solution is obtained. Unfortunately, the funds which were available for this work will be exhausted by the time of the 1933 Annual Meeting. It will, therefore be necessary for the Committee to abandon this work until conditions are such that it can be supported or some other organization can be prevailed upon to continue the investigation. (A report will be submitted at the February Meeting by Mr. Poste covering his work to date and will be published in the *Journal* of this Society.)

No work has been done during the past year on sheet-steel enamel problems. This has been due largely to the inability to organize the sub-committee on sheet-steel enameling research, under present conditions, for the study of important problems which were under consideration. The "reboiling" of ground-coat enamels on sheet steel is of extreme importance and it is now the general belief that there may be a very close relationship between this phenomenon and the blistering which occurs in enamels on cast iron.

For the investigation of the fundamental properties of enamels, the Research Committee has depended largely on the coöperation of the various federal bureaus and universities. There has existed in the past a fine spirit of coöperation between the Bureau of Standards and the Enamel Division in the investigation of enameling problems, and it is hoped that this coöperation may be extended to the various research institutions interested in the enameling industry.

In addition to these problems of a fundamental nature and those of an industrial character, so-called shop problems, there are those which are of immediate industrial importance and at the same time are so broad that it is impossible for any single scientific research or industrial laboratory to solve them. Such a problem is the investigation of the causes of blistering of cast-iron enamels on which the Enamel Division has been laboring for the past six years. The Division was fortunate in having the splendid coöperation of the Bureau of Standards in the earlier phases of this investigation.

Such work as the Bureau of Standards studies of the fundamental properties of enamels, the work of the University of Illinois Ceramic Department on X-ray studies of enamels, and the series of studies of adherence of enamels by the Ohio State University Ceramic Department show that these research staffs are aware of our needs. That the industrial organizations are also alert to their responsibilities is evident in the publications, reports, and new developments which are coming from them.

The question naturally arises as to how the scientific research organizations can be of greatest assistance to the industry, and how the industry can be most helpful to the men in the scientific research laboratories, for each group is dependent on the other for progress. The bureaus and universities can accomplish most by closely adhering to their programs in studies of fundamentals.

On the other hand, the practical and technical men represented in the Enamel Division have a vast fund of knowledge and experience which could be made available to those in the universities and government laboratories. The men engaged in scientific research undoubtedly welcome contact with the members in industrial work in order that they may have the best understanding of the problems of the industry and at the same time receive the benefit of industrial counsel and aid in the solution of these problems as they attack them in the research laboratories.

The nature of the cast-iron problem which has occupied the attention of the Research Committee has necessarily demanded that the committee be composed largely of industrial representatives. The time has arrived, however, when the committee should broaden its field of activities, and bring about real coöperation between the industrial groups and the scientific research laboratories. A research committee composed of representatives of the several branches of the enameling industry could arrange for this coöperation. This committee need not consist of more than three members but should be entirely familiar with the personnel and facilities of the various scientific and industrial laboratories for research on enamels.

Instead of a single research committee attempting to cover the entire field of research or to furnish the coöperation, we shall then have research groups appointed to coöperate in the investigations in which they are most interested and best qualified to assist. There could be as many research groups as there are problems which can be properly investigated by such coöperative groups. Those studies which any organization might desire to make under its own facilities would not come under this coöperative plan, but practically all of the important problems of the enameling industry require the cooperative efforts of the men in the scientific research laboratories and those in the industrial laboratories and shops if they are to be solved in the shortest time and at the minimum cost. Such problems are the blistering and boiling of enamels on both cast iron and sheet iron and steel, the compilation of data on the physical properties of enamels,

the study of furnace atmosphere and its effect on enamels, the investigation of the constitution of enamels, the mechanics of enamel adherence, and others which now command our attention, often with much unnecessary duplication and even waste of effort.

Your committee recommends that the Enamel Division organize for coöperative effort under the plan proposed or such modifications of it as may be desired.

Respectfully submitted,

R. R. DANIELSON, *Chairman*
M. E. MANSON, *Sub-Committee on Cast-Iron Enameling*
B. T. SWEELY, *Sub-Committee on Sheet-Steel Enameling*

Research Committee of the Enamel Division Cast Iron Research Fund

Treasurer's Report, April 1, 1933

Receipts

Balance on hand, February 1, 1932	$638.13
Contribution Ferro Enamel Corp., Nov. 2, 1932	50.00
General contributions at Pittsburgh Meeting, Feb. 14, 1933	64.00
	$752.13

Disbursements

To Dr. Comstock for metallographic work, Feb. 27, 1932	$ 86.40
To Emerson P. Poste for research work, on monthly statements Feb. 1, 1932 to March 31, 1933	650.77
Check tax	.16
Lantern slides and blueprints	14.80
	$752.13
Balance on hand, April 1, 1933	000.00

R. D. WELLS, *Treasurer*

PROPOSED AMENDMENT TO ENAMEL DIVISION BY-LAWS

Three members of the Enamel Division shall act as an Editorial Committee. The Division Chairman shall appoint three members to act as the first Editorial Committee. One of these shall be designated to act for one year, one for two years, and the third for three years. Succeeding Division Chairmen shall each year appoint one member of the Division to serve on this Committee for three years. The Chairman of the Committee each year shall be the member retiring at the end of that year. The retiring member may be reappointed if the Chairman of the Division so desires.

CLAY PLANT ECONOMIES

Progress Report of Technical Committee No. 11 of the National Brick Manufacturers Research Foundation

NOTE: This report under date of January, 1933, was prepared by T. W. Garve, Committee Chairman, and the following Committee members: Davis Brown, J. L. Carruthers, R. G. Cox, Charles A. Nicely, and C. G. Powell. The Report was presented at the Annual Meeting, AMERICAN CERAMIC SOCIETY, Pittsburgh, Pa., Feb., 1933.

I. Introduction

This Report is presented in two parts, (1) that which deals with economies that have been fully tested in the clay plant and whereby definite figures of saving have been obtained with an up-to-date approval of the respective clayworker, and (2) that which

lists such economy items that could not be traced to a single source but are worthy of consideration and while having proved their worth, could not be translated into definite figures of saving expressed in dollars and cents, or pounds of fuel or time or labor.

NOTE: It might have been more advantageous to arrange the main classification along the following lines: (1) the first part to list nothing but basic items of economy or such items that are universal and therefore would apply to any clay plant, and (2) the second part to bring dependable items or those which, to effect a saving, depend upon existing conditions such as the character of the clay and the kind of ware. These items may have proved their value in one plant but do not necessarily effect a saving in another plant; in fact they may become quite a detriment. Kiln-crown insulation might be cited as an example of the first kind. "Wheelbarrow *vs.* truck" could be used as a second example, the wheelbarrow being more advantageous for plants making a great variety of texture or color requiring handling in smaller units and great flexibility, or for small kilns, while the lift truck will ordinarily prove of greater advantage for single-ware plants requiring little shading or selection. The items of the first kind could be accepted unconditionally while those of the latter should be met with caution or require investigation and tests. While such a classification is more difficult to carry through, its advantages are obvious and this Committee is open for suggestions.

Details have been omitted so as not to obscure the issue and because they express largely local peculiarities. The items presented serve merely as a stimulus since conditions in the clay industry vary greatly.

Part I

(1) *Clay Loading; Hand shoveling vs. mechanical loader;* loading shale from storage shed during winter for delivery to grinder, making 65,000 brick in 8 hours.

	Labor	Saving	Source and date
Hand shoveling	12 men		Roanoke-Webster Brick Co., Roanoke, Va.; confirmed by W. W.; hobby of above Company; Dec., 1932
Haiss caterpillar loader (with bucket elevator)	2 men	10 men	

(2) *Clay Storage and Automatic Handling*

Conditions	Saving	Source and date
Raw clay storage building 360 by 75 ft. with overhead crane and clamshell bucket, handling clays from delivery to any place of storage and to overhead bins; measuring cars below bin spouts along grinders; permitting storage by-pass; labor 3 men; investment not stated	Cost of handling reduced ⅔ over old system with barrows	Gladding, McBean & Co., Lincoln, Calif.; F. H. Riddle, *Trans. Amer. Ceram. Soc.*, **19**, 314 (1917)

(3) *Wheelbarrow vs. Storage Battery Lift Truck*

		Loading brick	Speed (miles/hr.)	Saving	Source and date
(*a*)	Wheelbarrow	100	2		M. D. Valentine & Bro. Co., Woodbridge, N. J.; *Brick Clay Rec.*; confirmed by F. R. Valentine, Dec., 1932
	Lift truck	500–1000	4–6 Move 22½ T./hr.	Labor reduced about 33%	
(*b*)	Wheelbarrow	100	4		Adel Clay Products Co., Adel, Iowa; H. R. Straight, *Bull. Amer. Ceram. Soc.*, **9** [4], 91 (1930)
	Lift truck	1000	10	$500 per year or $17 per truck per day	

(*c*) Lift truck	504	7 men	Monongahela Clay Mfg. Co., Monongahela, Pa.; *Brick Clay Rec.*, Aug., 1926; confirmed by Company, Dec., 1932

NOTE: The Wyandot Clay Products Co. (Robert L. Hare) reports that wheelbarrows have proved more economical than the lift truck. See above Introduction.

(4) *De-Airing Clay:* Permitted elimination of 30% imported clays used as a binder, in California operations, for sewer pipe and brick; by Gladding, McBean & Co., and Pacific Clay Products Co., in 1932; for additional items see Part II.

(5) *Ball Bearings*

Use	Saving	Source and date
Ball bearings used by Company since 1918; first motor was installed on drier fan, running continually 9 months out of the year, required regreasing twice during this time		Reported by H. C. Kleymeyer, Standard Brick & Tile Co., Evansville, Ind., Dec., 1932
At West Point, Ky., plant, Company replaced all babbitt bearings by new shaft with 4 ball bearings, reducing power bill to an average of	$60 per month, paying for new equipment in 1 year	
Ball bearings also used on wheelbarrows together with rubber tires and springs; very satisfactory		

(6) *Roof-Tile Cutter*

Conditions	Saving	Source and date
Automatic cutter replacing hand cutter	30% increased production and better product	Used by Gladding, McBean & Co., Pacific Clay Products, Consolidated Brick & Tile, and San Valle Tile Co.

(7) *Stellite*

Conditions	Saving	Source and date
Coating the knives of auger machine with 1/4 in. stellite	Increased life of knives about 3 times; cost and power increased; maximum production is easier maintained; actual saving not yet known	Watsontown Brick Co., Watsontown, Pa., Dec., 1932

(8) *Die Improvements*

Condition	Saving	Source and date
To have lubrication where pressure is greatest, a Chambers oil-lubricated die was separated in 2 pieces where taper is greatest (about 6 in. from bell of die), 4-point lubrication being inserted between the pieces, with a pump pressure of 150 lb. for a stiff column.		Watsontown Brick Co., Watsontown, Pa., Dec., 1932
A 'grinding device was rigged up consisting of an emery wheel fastened at right angles to a flexible shaft for grinding the tapered part of the die when worn.	Has overcome the trouble that always started when grooves and holes were worn in the smooth surface; life of die was increased 4 times	

(9) *Power Cost (Comparative)*

	Cost/kw.-hr. (cents)	Cost/M brick (dollars)	Additional considerations
Local steam engine	1.5–3	1.10–2.25	Additional investment of boiler, engine, buildings; engineer required; steam available for drying (40% of fuel value)
Purchased electric power	1–2	0.75–1.50	Flexibility of arrangement; practically no attention, investment in motors
Diesel or uniflow engine	1	0.75	Additional investment of prime movers and power house with boilers for uniflow engine; engineer required for uniflow engine; steam available for drying with uniflow engine

(10) *Power cost (Diesel vs. Electric)*; including investment, depreciation, maintenance, fuel, oil (labor not stated).
260 h.p. engine, 2,000,000 brick per month or about 77,000 brick per day

Cost per M		Saving using Diesel	Source and date
Diesel	Purchased electric power ($1.46 /kw.-hr.)		Corinth (Miss.) Brick Co., from Ceramic Products Cyclopedia, 1932
$0.283	$0.598	$0.315 / M	

(11) *Kiln Insulation: fuel saving:* firing building brick in downdraft kilns.

Conditions	Fuel saving	Source and date
(*a*) Rectangular kiln; 1800°F Crown insulation: 9-in. fire brick; nonpareil on edge 2½ in. common brick NOTE: Mention advantage of insulation in the use of waste heat from kilns; report recent use of Sil-O-Cel powder and special furnace cement (nonshrinking) instead of fire clay to bond, with similar savings in fuel	From 978–889 lb./-M equal to 9%	Millikan Brick Co., Wilkinsburg, Pa.; published about 1932; confirmed by Company Dec., 1932 (see note)
(*b*) Rectangular kiln; 2020°F Crown insulation: 9-in fire brick 1½-in. Superex ½-in. cement 1½-in. Superex ½-in. cement 2½-in. red brick ½-in. Insulkote	13.3%	Hazleton Brick Co., Hazleton, Pa.; no confirmation received
(*c*) 30- and 36-foot diameter round kilns 1850°F Crown insulation: 9-in. fire brick 2 flat insulating brick 1 layer common brick and water-proofing	3–5 T. coal/firing, *i.e.*, 3 on drain tile 4 on building tile 5 on brick	Galena Shale Tile & Brick Co., Galena, O.; B. L. Shultz, Dec., 1932

(12) *Fuel Saving Due to Size of Kiln*

Conditions	Saving	Source and date
(*a*) Kiln, 26-foot diameter; 64 T. ware (4-in. drain tile) requiring about 350 lb. coal/T. of ware. Total 22,400 lb. or 22.4 T. coal		Compiled Dec., 1932

	Conditions	Saving	Source and Date
	Kiln, 30-foot diameter; 82 T. ware (4-in. drain tile) requiring about 310 lb. coal/T. of ware. Total 25,400 lb. or 25.4 T. coal	15 T. ware in larger kiln cost nothing for fuel, or 12% fuel saving	
(*b*)	Kiln, 30-foot diameter; drain tile of various sizes; averages 382 lb. coal/T. of ware		Hancock Brick & Tile Co., Findlay, Ohio, Dec., 1932
	Kiln, 36-foot diameter; drain tile of various sizes; averages 342 lb. coal/T. ware	40 lb. coal/T. ware saved in larger kiln	

(13) *Coal Unloading, etc.*

Cost of unloading coal and delivery to kilns and boiler, also cleaning up, including interest on investment, depreciation, and upkeep.

Conditions	Saving	Source and date
3 horses with carts and 3 cart drivers; 1 extra man for boiler delivery, part time; $13.26 per day		Southern Fire Brick & Clay Co., Montezuma, Ind., 1927
Galion coal unloader and Wher tractor, using 2 operators; $8.85 per day	$4.41 per day	

(14) *Kiln Crown Rectangular Kiln*

Conditions	Saving	Source and date
Crown 12 in. deep instead of 9 in.; each 12-in. brick arched in perfect crown or curve	Lasts 5 times as long as crowns built in usual way	W. D. Richardson, Dec., 1932

(15) *Cooling Kilns by Fan*

	Conditions	Saving	Source and date
(*a*)	Two fans, one for quick cooling and one to play on drawing gang	Time of kiln turnover reduced 2 days	Cherokee Brick Co., Knoxville, Tenn. (from old clipping)
(*b*)	Fan for cooling, after opening of kiln door	24 hr. in cooling time	Galena Shale Tile & Brick Co., Galena, Ohio, B. L. Shultz, Dec., 1932

(16) *Watersmoking by Fan*

Conditions	Saving	Source and date
Induction fan with $7\frac{1}{2}$ h.p. motor	Done in 14 hr. against 72 hr.	Galena Shale Tile & Brick Co., Galena, Ohio, B. L. Shultz, Dec., 1932

(17) *Stoker Firing*

	Conditions	Saving	Source and date
(*a*)	50 T. of coal for 200 T. of dry-press brick to cones 6–8 during 13 days firing, using Gates stoker	10 to 20% of coal over hand firing	Illinois Clay Prod. Co., Goose Lake, Ill.; *Brick Clay Rec.*, March, 1932
(*b*)	John D. Martin automatic stoker, including automatic removal of ashes	30% of coal over hand firing	Moulding-Brownell Corp., New Straitsville, Ohio, Jan., 1933

NOTE: The 35 to 50% fuel saving claimed by the Roseville (Ohio) Experiment Station applies to extraordinary conditions, *e.g.*, use of a large stoker entirely outside of kiln and convict hand labor under the supervision of combustion engineers.

(18) *Forced Draft in Kiln Firing*

	Conditions	Time of firing (days)	Coal (lb./M)	Saving in coal (lb./M)	Source and date
(*a*)	Natural draft	7½	1307		Peoria Brick & Tile Co., Peoria, Ill.; *Brick Clay Rec.*, May, 1919
	Forced draft	3½	997	310	
	Forced draft (now using larger kilns and different shale making much denser brick and using poorer coal)	4½	1200	310	Reported by C. E. Carter of above Company, Dec., 1932
(*b*)	Natural draft		1200		Monongahela Clay Mfg. Co., Monongahela, Pa.; confirmed Dec., 1932
	Forced draft		900	300	
(*c*)	Firing brick in 36-ft. kiln with W. Va. nut, pea, and slack				Wyandot Clay Prod. Co., Upper Sandusky, by Robert L. Hare, Jan., 1933
	Forced draft	107 hr.	640/*M* 285/T. ware	About 3 to 5 T. coal /kiln	
	Firing tile in above kiln with W. Va. wash nut			and	
	Forced draft	102 hr.	300/T. ware	about 45 hr. total time	

Part II

(1) *Car pulling device*, for level drier tracks, consisting of underground shaft, spools, cables, and ropes with hooks for pulling string of cars through each drier tunnel, erected at end of cooling tracks will save labor (originated by W. D. Richardson).

(2) *Locking device for transfer car* to spot in line with each drier track and loading track will save time and avoid wrecks (originated by W. D. Richardson).

(3) *Swivel-wheel industrial cars* are often valuable in replacing wheelbarrows or track industrial cars. They can be turned in their own length in kiln or railroad car, and can be spotted anywhere in kiln. Galena, Ohio, uses track and flat-wheel car with a swivel-wheel; for distant movement the car runs on a track and for short movement it runs with flat-wheel flanges on the level ground (kiln floor), permitting close spotting.

(4) Practically any *waste-clay conveying system* will save labor.

(5) By using *single deck drier cars*, passing under the take-off belt at right-angles to it, the movement of the hacker is but one-quarter turn without taking any steps, and he has to reach but half across the car since there is a hacker on the other side. One man may hack from 20,000 to 25,000 brick per day against 15,000 if standing sidewise between belt and car. A single-deck car, instead of double- or triple-deck cars, may be profitable in many instances. Many plants will permit remodeling along this line involving, perhaps, changes in the drier, etc., but all leading to considerable economies.

(6) *Transfers* are preferable to turn-tables.

(7) *Belt conveyers* are preferable to bucket elevators.

(8) For *short drives*, the flexible (multiple or single) V-belt is preferable to the silent chain.

(9) *V-belt drives*, as a rule, have a higher efficiency factor than geared speed reducers.

(10) *Handling in large units* is more economical than handling in smaller units but the elimination of the wheelbarrow due to its flexibility requires investigation.

(11) *De-airing clay* gives a smoother bar, corrects or lessens torn corners, increases the strength of the wet-clay product several hundred per cent, notably increases the strength of the dry ware, increases the strength of the fired ware, increases the density of the fired ware; or the clay may be fired at a lower temperature (thus saving fuel) and obtain the same strength and equally low porosity.

It overcomes blisters and eliminates the serious effects of laminations. Structural tile may be made with thinner walls, thus reducing the weight without sacrificing the strength. Weaker clays now impractical for hollow tile will be advanced to the status of some stronger clay now in use. The drying behavior is improved in part due to the greatly increased wet strength.

(12) *Die lubrication* by electricity.

(13) *One grinder* is preferable to 2 or 3 dry pans.

(14) All *yard wheelways* to be paved and shedded, a worthwhile and simple economy, yet not always done.

(15) The use of all *waste heat from firing and cooling kilns* for drying. Existing kilns and driers may easily be modified to accomplish this economy.

(16) *Blowing boiler flues* every 6 hours instead of every 24 hours will save considerable fuel.

(17) The *insulation of the kiln*, especially of the kiln crown, is a notable fuel saver but the crown brick must be high grade. See also Part I.

(18) The *regenerative system of downdraft kilns*, utilizing the hot gases from the fired kiln to preheat two kilns ahead. In such a system, the heat from cooling kilns can generally be used more effectively and economically in the waste-heat drier. New plants, unless a continuous type of kiln is used, should be built along these lines and old plants will often permit remodeling to obtain above conditions and economies.

(19) *Elimination of underground water* from below kiln bottoms by proper drainage (and perhaps insulation).

(20) *Kiln bottom* with properly distributed and proportioned outlets and flue system to obtain uniform temperature (not uniform draft) throughout the kiln.

(21) Use of perfect arch brick (not straights), at least 9 inches instead $4^1/_2$ inches deep, or the use of a few special large blocks (shapes) to form the *furnace arches* (advocated and used by W. D. Richardson and others).

(22) The *inner wall of a round downdraft kiln* expands in greater degree than the outer wall causing rupture of the outer wall and leakage. The inwall should be independent of the outwall and permit expansion.

(23) *Bulged kiln walls* at the base of the kiln are caused by expansion of the kiln floor and flue walls. These walls and the floor should be kept clear of the kiln wall and provision for expansion be made.

(24) *Leakage through the kiln wall* at the base of the kiln cools the floor level and makes it difficult to heat the bottom. Occasional daubing will help but it would be better to case the lower part of the kiln with sheet iron to stop all leakage and reduce the radiation loss.

(25) Use of the *suspended kiln top* instead of the conventional crown, requiring no or little wall bracing. This removes the main objection to the rectangular kiln.

(26) *Furnace fires in downdraft kilns* should be down to or below the kiln floor to get the heat to the bottom of the kiln.

(27) *Too many furnaces* or furnaces too large in size cause loss of fuel.

(28) *Insufficient furnace power*, necessitating constant crowding of the furnaces, requires additional fuel and is hard on the furnaces, etc.

Respectfully submitted,

T. W. GARVE

LOCAL SECTION NEWS

Baltimore-Washington Section

A meeting of the Baltimore-Washington Section of the American Ceramic Society was held April 8, 1933, at Baltimore, Md. The speakers were James C. Vail, Chemical Director, and William Stericker, Chief Chemist, of the Philadelphia Quartz Company.

An illustrated talk covering the use of silicate in deflocculating clay for casting pottery of various kinds, cement, enameled brick, paints, or coatings was given. The reaction between soluble silicates and insoluble silicates was discussed.

Pittsburgh Section

March Meeting The Pittsburgh Section of the American Ceramic Society on March 20 heard an unusually interesting address by A. K. Bradley, Manager of the Gas Producer Department of the Morgan Construction Company. After a brief introduction, his subject, "Producer Gas in the Ceramic Industries," was handled as a round table discussion in which Mr. Bradley replied to questions. The discussion became essentially an operators' meeting and was participated in chiefly by members who are operating producer plants in manufacturing glass and refractories.

Mr. Bradley stated that the gas producer machine, used for many years without major improvement, has in more recent years undergone a development which, for a machine of the same size, has increased the maximum capacity of coal consumed per hour from 1800 pounds to 5000 pounds. This increase in capacity has resulted primarily from increasing producer speeds from 15 to 30 minutes per revolution to 6 to 7 minutes per revolution. Automatic operation as to steam-pressure control, coal feed, and ash removal became fully developed about ten years ago. As a result of these improvements which most plants have now adopted, it became possible for one man to operate an entire producer gas plant of two to five machines, provided proper facilities are installed for mechanical handling of coal and ash.

Automatic temperature control was discussed. A few plants have recently installed systems which permit the regulation of temperature by automatic control of the control feed. Mr. Bradley predicted that this type of control will be more fully adopted.

Automatic ash removal, both continuous and intermittent, was discussed and it was the consensus of opinion that most operators prefer intermittent removal.

The complete report of the Annual Meeting Committee was presented by Dr. Alexander Silverman.

April Meeting At a meeting on April 11, 1933 at Mellon Institute, William Stericker, Chief Chemist of the Philadelphia Quartz Company, gave a talk on "Sodium Silicates in the Ceramic Industries."

Pittsburgh Section to Honor Dr. Nelson W. Taylor*

On May 9 the Pittsburgh Section of the American Ceramic Society will honor Dr. and Mrs. Nelson W. Taylor at a dinner to be held in the Cafeteria Room of the Carnegie Library in Pittsburgh. Dr. Taylor became head of the Department of Ceramic Engineering at Pennsylvania State College, January 1, 1933. The dinner, for which a charge of 75 cents a plate is to be made, will be at 6:30 P.M. All persons on the mailing list of the Pittsburgh Section will be supplied with a card for making reservations. Others are requested to notify R. E. Birch, 1800 Farmers Bank Building. An invitation has been extended to members of the Pittsburgh Section of the American Chemical Society.

* R. E. BIRCH, *Secretary*.

The ladies are invited to attend the dinner and a special entertainment will be provided for them by the staff of the Carnegie Art Institute after the dinner.

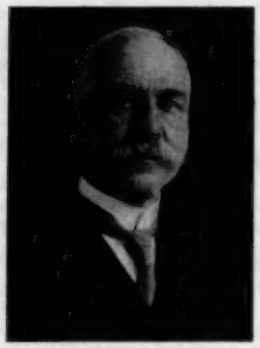
The Section will be addressed by Dr. Taylor, whose subject will be "Chemical Reaction between Solids." In the work which he will discuss, the components were finely ground and pressed together under high pressures. After sintering from 20 to 24 hours at about 1000°C, the products were examined with X-rays by the powder method for the identification of new compounds. Reactions occurred between ZnO (or NiO) and SiO_2, TiO_2, and SnO_2, giving rise to structures like spinel, olivine, and ilmenite. Dr. Taylor will discuss the work of other investigators in this field, as well as the general mechanism of such solid phase reactions and the bearing of these processes on refractories.

NECROLOGY

Charles W. Crane

Word has been received of the death of Charles W. Crane in Elizabeth, N. J., after about a year's illness. He would have been eighty-one years old on April 19, 1933.

Mr. Crane was a descendant of Jasper Crane, one of the founders of the city of Newark. He was born in Elizabeth, N. J. At the age of sixteen he entered the shipping business in the employ of the late Elias D. Smith of Elizabeth. He organized the firm of Charles W. Crane and Company in 1895 and eight years later organized the Crossman and Company to dredge sand and mine clay in Sayreville, N. J. He was president and treasurer of the latter Company.



C. W. Crane

Mr. Crane was vice-president of the New Jersey Manufacturers Casualty Insurance Company and a director of the Elizabethport Banking Company in Elizabeth. He served as chairman of the Board of Trustees of the Manufacturers Association of New Jersey, and for twenty-one years was president of the Union County Building and Loan Association of Elizabeth, N. J.

He was vice-president of the Union County Historical Society and a member of the Maritime Association of the Port of New York. From 1917 he held membership in the American Ceramic Society and was Councilor of the Ceramic Association of New Jersey, in which he was intensely interested. Through the latter Association he assisted the late Charles A. Bloomfield and others in establishing a Department of Ceramics at Rutgers University.

Mr. Crane was a member of the original board of directors of the Elizabeth Y. M. C. A. and for many years was superintendent of the Sunday School of the Greystone Presbyterian Church in Elizabeth.

Two daughters, Mrs. Mary C. Hahn of Elizabeth, and Mrs. Harriet C. Latham of New Britain, Conn., survive. Mr. Crane leaves a legion of friends in all walks of life to mourn his passing.

Mr. Crane was a regular attendant at Meetings of the American Ceramic Society and of the Ceramic Association of New Jersey. Quiet, tolerant, broad in experience, and catholic in thought Mr. Crane endeared himself to all with whom he contacted.

NEW MEMBERS RECEIVED IN MARCH

PERSONAL

Helen Blair Barlett, Petrographer, A C Spark Plug Co., Flint, Mich.
Chadwick N. Heath, 99 Chauncy St., Boston, Mass.; National Fireproofing Corp.
Walther Kurz, 309 S. Main St., Abingdon, Ill.; Chemist, Abingdon Sanitary Mfg. Co.

Alexis Pincus, 44 Suydam St., New Brunswick, N. J.; Rutgers University.
George R. Sylvester, Allied Engineering Co., 87 W. Main St., Columbus, Ohio.

STUDENT

Alfred William Beinlich, Jr., Missouri School of Mines and Metallurgy, Rolla, Mo.
Justus Jordan Beinlich, Missouri School of Mines and Metallurgy, Rolla, Mo.

Membership Workers' Record

PERSONAL		STUDENT	
R. F. Geller	1	C. M. Dodd	2
Alexander Silverman	1		
H. F. Vieweg	1	Grand Total	7
Office	2		
Total	5		

ROSTER CHANGES IN FEBRUARY AND MARCH

PERSONAL*

Abney, Charles L., Columbus Brick & Tile Co., Jacksonville, Fla. (Doctors Inlet, Fla.)
Ally, Abde, Department of Glass Technology, Sheffield University, Sheffield, England. (University of Illinois, Urbana, Ill.)
Graetz, Robert S., 1547 Lee St., Charleston, W. Va. (306 Davis St., Clarksburg, W. Va.)
Hertzell, E. A., 4435 Highridge St., Pittsburgh, Pa. (Harbison-Walker Refractories Co., Chester, Pa.)
Hodgdon, Frank B., 3 Riverview Pl., Davenport, Iowa. (Massachusetts Institute of Technology, Cambridge, Mass.)
Irving, Donald R., Box 1157, Richmond, Calif. (Greenville, Calif.)
Johnson, Frederick H., Klondyke P. O., East Liverpool, Ohio. (Forester Ceramic Art & Specialty Co., Summitville, Ohio.)
Kent, N. Johnson, 701 Kensington Ave., Plainfield, N. J. (21 Marshall St., Caldwell, N. J.)
McKeown, Thomas H., Color Department, Roessler & Hasslacher Chemical Co., Perth Amboy, N. J. (New York, N. Y.)
Meeka, Edward, 4349 Holly Hills Blvd., St. Louis, Mo. (Eagle-Picher Lead Co., Joplin, Mo.)
New, Ryland H., National Sewer Pipe Co., Ltd., Swansea, Ontario, Canada. (Metropolitan Bldg., Toronto, Ont.)
Rapp, Carl H., 566 E. Witherbee St., Flint, Mich. (Milford, Ill.)
Richardson, Gordon B., 116 New Montgomery St., San Francisco, Calif. (Livermore, Calif.)
Schotts, Walter H., 215 Estudillo Ave., San Leandro, Calif. (55 W. Star Ave., Columbus, Ohio.)
Smith, Louis A., 1000 Franklin Ave., Aliquippa, Pa. (Woodlawn, Pa.)

GLASS DIVISION COLLABORATED

DIVISION OF INDUSTRIAL AND ENGINEERING CHEMISTRY, AMERICAN CHEMICAL SOCIETY

D. B. Keyes, *Division Chairman,* **and E. M. Billings,** *Secretary*

Symposium on "Glass": F. C. Flint, Program Chairman.

The following program was given by the Glass Division of the American Ceramic Society at the Washington Meeting of the American Chemical Society.

* The address within parentheses represents the old address.

March 28, 1933

9:00 A.M.	(1)	F. C. Flint, Outline Problems, introducing speakers.
9:05	(2)	G. W. Morey, "Phase Equilibrium Relationships Determining Glass Composition."
9:50	(3)	J. T. Littleton, "Existence of Critical Temperature in Silicate Glasses."
10:35	(4)	Donald Sharp, "Glass Formulas, Material, and Composition."
11:50	(5)	Henry H. Blau, "Light-Diffusing Illuminating Glasses."
2:00 P.M.	(6)	G. E. F. Lundell, "Chemical Analysis of Glass, Past, Present, and Future."
2:45	(7)	Fred S. Thompson and Hobart Kraner, "Glasshouse Refractories, Past and Present."
3:30	(8)	W. Trinks, "The Effect of Flame Luminosity and of Other Variables upon the Economy and Capacity of Glass Tanks."
4:15	(9)	S. R. Scholes, "Methods of Melting Glass."

These papers will appear in due time in *Industrial and Engineering Chemistry*, a news publication of the American Chemical Society. Reprints will be sent to members of the Glass Division of the American Ceramic Society as soon as the same become available.

NOTES AND NEWS

CERAMIC SCHOOL NOTES

New York State College of Ceramics

The Alfred Ceramic Alumni Association held its annual dinner and meeting at the Smithfield Grill in Pittsburgh on Tuesday evening of the week of the American Ceramic Society Annual Meeting. The dinner and meeting was arranged by S. S. Cole. Thirty-six were present with R. F. Sherwood presiding. Much interest was expressed in the plans outlined by Dean Holmes for the dedication of the new ceramic building during Commencement week. The officers elected for the coming year are as follows: Dean M. E. Holmes, *Honorary President*, George Crawford, *President*, S. S. Cole, *Vice-President*, R. D. Whitford, *Secretary-Treasurer*, J. E. Eagle, *Executive Committee Member*.

The Ceramic College was the meeting place for a Committee of glass technologists, Dr. Scholes and Dean Holmes acting as hosts. These men represented a group from the Glass Division of the American Ceramic Society which plans to present a one-day symposium on glass at the meeting of the American Chemical Society in Washington, D. C., this spring. Those who attended were: Francis E. Flint, Washington, Pa., J. C. Hostetter and J. T. Littleton of the Corning Glass Works, G. W. Morey of the Geophysical Laboratory in Washington, and Donald E. Sharp of Hamburg, N. Y.

The Ceramic Guild recently sent two of its members, Maxine Armstrong and Mary Olney, to New York, N. Y., to attend various important art exhibitions. They reported in detail to the art students at the last meeting of the Guild.

The College has received several samples of beautiful glassware for permanent exhibition from the Fostoria Glass Company of Moundsville, West Va., and the Steuben Glass Company and the T. G. Hawkes Glass Company of Corning, N. Y.

New York State College of Ceramics Honored by First Visit of Saint Patrick, Patron Saint of Engineers

The College of Ceramics at Alfred, N. Y., is the first ceramic engineering school which, by itself, has staged a Saint Pat's Celebration. March 15 and 16 were the days set aside for this first triumphal visit.

Saint Pat was represented by F. W. Muller, a senior engineer, who was chosen for his popularity among the students. A parade heralded his arrival on a white horse surrounded by his ten trusty henchmen, all in appropriate costumes. Floats in the parade depicted various local events, such as the burning of the girls' dormitory and Alfred faculty in the "gay nineties." The parade ended at Alumni Hall where Saint Pat was

scheduled to speak on his first impression of the College. He seemed to have been most impressed by the eccentricities and humorous characteristics of faculty and outstanding students. At the close of his speech, senior engineers and faculty members were ceremoniously dubbed Knights of the Order of Saint Pat.

Following this ceremony a lunch of corned beef and cabbage was served in the kiln room of the new ceramic building. On Wednesday afternoon a tea dance was held. The walls were decorated with green and silver panels designed in harps and shamrocks.

The Open House on Wednesday evening marked the first occasion when all the recently installed equipment in the new ceramic building was in use. Seven hundred guests from many surrounding towns, especially high school students who were interested in entering college, attended. All of the laboratories throughout the building were in use by students with members of the faculty in charge, and the work being done was the same as the regular classwork.

Groups of the visitors were escorted through the building by student guides who explained the various processes being demonstrated in the laboratories. The Physics Laboratory offered a display of microscopes with specimens of various minerals and methods of determination. Quantitative and qualitative analyses were being run in the Chemistry Laboratory. The equipment in the Ceramic Laboratory, including an air processing cabinet, a humidity drier, electric ovens, blunger, and ball mill, was all in operation. Methods of molding, sieving, and testing materials were demonstrated by the students.

The Art Department featured an exhibition of pottery, as well as classes in drawing, design, and various methods of decorating ceramic ware.

Students were operating the slip plant, the sandblast machine, the grinding and crushing equipment, the wet pan, and the hummer screen, and were making sample brick in the auger machine. There were demonstrations of throwing, turning, jiggering, and pressing pottery in the plaster shop. In the kiln room ten furnaces were in operation and two glassblowers were demonstrating. The glassblowing was the most interesting feature of the evening, and was arranged by Dr. Hostetter of the Corning Glass Works. Dr. Littleton, Mr. and Mrs. McKaye, and Mr. Gregory of Corning accompanied Dr. Hostetter to Alfred for the evening.

The batch of glass had been mixed and melted by the glass technology students under Dr. Scholes' supervision and according to the glassblowers, "it was a sweet melt." The glassware blown that evening is on exhibit at the College. The glassblowers obligingly remained late in the evening so that the students could have a better opportunity to see the process.

Attractive green glazed pottery ash trays which had been made by the students were sold to the guests as souvenirs.

Following the Open House a movie was given in Alumni Hall as another feature of the celebration.

On Thursday afternoon the Footlight Club presented a matinée performance of Madame Butterfly as part of the two-day celebration.

The climax of the festivities was reached Thursday evening at the formal ball in the gymnasium, which was presided over by Saint Pat and his Queen. The Queen of the festivities was elected by popular vote of the student body several days before the Ball. Miss Elsie Bonnet, a Junior in the Applied Art Department of the College, was singled out for this honor due to her outstanding popularity. The ball marked the occasion for the crowning of the Queen whose identity had been withheld until that time.

The whole celebration was most successful and great credit is due the Committee of senior engineers who carried out the plans. Since St. Pat's initial appearance was so well received there is no doubt that he will make this an annual visit. Not only was the celebration successful socially and financially, but the attitude of coöperation necessary to the success of such an enterprise will help to strengthen the spirit and morale of the student body in all its activities.

AMERICA'S ONLY CERAMIC COLLEGE
NEW YORK STATE COLLEGE OF CERAMICS, ALFRED, N. Y.

Dedication of New Building, June 12, 1933

Claiming to have the largest building devoted entirely to ceramics and the use of two other buildings; claiming the largest faculty and student enrollment; claiming the first and only four-year collegiate course of glass technology; and certainly being the

only ceramic college with a Dean and several departments, the ceramic college at Alfred University has every reason to make "a big day" of June 12, 1933, the day of the formal dedication of the new building.

More than a dedication of a building, this event will be the induction of America's first and only Dean of a college of ceramics, Major E. Holmes, and the dedication of American's only collegiate department of glass technology, Samuel R. Scholes, director.

Coincidently, June 12 will be the last day of thirty years of active service of Dr. Boothe C. Davis as President of Alfred University. Much credit has justly been given to Dr. Charles F. Binns for developing ceramics at Alfred University during the last three decades but to Dr. Davis belongs the vision, the constructive leadership, and the inspiration which culminated during the past year in the New York State College of Ceramics. No small part of the honors and appreciation by the ceramists of America on June 12 will be directed to President Boothe C. Davis.

Albert Victor Bleininger Honored

The program for June 12 at Alfred schedules addresses by Governor Herbert Lehman, Education Commissioner Frank Graves, and the President of the American Ceramic Society, John C. Hostetter.

Reciprocating in honors bestowed and congratulations extended, Alfred University and the New York State College of Ceramics will confer an honorary degree of Doctor of Science on Albert Victor Bleininger. Mr. Bleininger will make the principal commencement address.

Dean Holmes is anxious to have a goodly representation of the ceramic technologists and industrialists present at the dedicatory meetings. An instructive and entertaining time is assured. This day will be of especial interest to the ceramists of New York State and the alumni of Alfred University.

THE FOURTEENTH EXPOSITION OF CHEMICAL INDUSTRIES

This Exposition occurs during the week of December 4, 1933, in New York. As usual, three floors of Grand Central Palace have been reserved. In keeping with the improved business attitude, the spirit of contest among exhibitors for choice positions along the various aisles is reflected in the fact that already over one hundred and fifty companies have contracted for space.

OWENS-ILLINOIS EXHIBIT AT CHICAGO'S CENTURY OF PROGRESS EXPOSITION

Among the many exhibits now being prepared for the Century of Progress Exposition after its opening on June 1 is a glass block building in course of erection by the Owens-Illinois Glass Co., Toledo, Ohio.

This building, 100 ft. long and 60 ft. wide, surmounted by a tower of colored glass blocks 50 ft. high, marks a new era in modern architecture and presages interesting departures from the past traditions of the building industry.

The glass block is a strong, six-sided building block, of plain surfaces, with a hollow center. It is made by pressing separately a five-sided unit and a lid, then hermetically sealing in the lid as the sixth side, providing an air-tight cavity within each unit.

Any color in the spectrum is applied to these blocks, giving an immense range to their decorative possibilities. The color is applied to five sides of the flint block, the outer or weather surface being left plain. Under certain conditions

of lighting interesting triangular shadows play through the wall cast from one unit to another by the blocks themselves. Pleasing variations in color effect result from changes in lighting conditions from without and within.

The block is a glass unit of uniform strength that has withstood exhaustive tests entirely satisfactory to the building profession. Although not intended as a load-bearing material it is capable of sustaining heavy loads, and with proper lateral stiffness for 4-inch thick walls, it easily meets building-code requirements.

Its hollow center gives it the further advantage of excellent insulating qualities, keeping out heat in summer, and reducing heating costs in winter.

Further advantages of the glass block lie in its transmission of light and uniform transfusion of light, without casting shadows, a feature of great value in many kinds of industrial and commercial buildings, and one which can be used to reduce greatly costs of construction of various types of buildings.

To effect a bond between the mortar and the glass block, to prevent the mortar from dropping off the block, to prevent water from penetrating the wall between the block and mortar, and to eliminate the unsightliness of air pockets in the mortar, the surfaces which would normally be in contact with the mortar are painted in the factory with a cement paint.

It is from the variations of color applied to the surfaces of the blocks themselves or introduced into the cement paint that the wide range of color effects in the glass blocks is achieved. Light reflected from the surfaces in contact with the mortar gives the effect of tinted glass.

The translucency of the blocks, admitting light to the building and at the same time permitting the reflected light from the colored cement coating to be diffused throughout each block, produces a varied pattern which changes continuously with the observer's perspective and with variations in lighting conditions.

OUR PAST-PRESIDENT POSTE

Eastern Tennessee now has a well-equipped commercial chemical laboratory. After three years of consulting work in analytical and industrial chemistry while with the Chattanooga Stamping & Enameling Co., Emerson P. Poste has now established his own laboratory at 99 Market St., Chattanooga. Irvin H. Barrows is associated with him.

Following graduation from the Carnegie Institute of Technology, Mr. Poste had fifteen years of general chemical engineering experience in Pittsburgh and Elyria, Ohio. After this came eight years of chemical engineering for the Chattanooga Stamping & Enameling Company. During the last three years he has been developing his consulting practice.

Mr. Barrows is a graduate of the University of Chattanooga. Following his graduation, he spent several years in industrial analytical work, foundry control, and enamel development and control in one of the largest plants in the South. He has been associated with Mr. Poste for the last three years.

This experience together with a complete new laboratory, operated under license of the Tennessee Board of Examiners makes possible an unusually efficient consulting service.

INTERNATIONAL CONGRESS OF GLASS AND CERAMICS

Milan, September 16–25, 1933

General Program and Program for Ladies

Saturday, September 16: arrival at Milan.

Sunday, September 17:

Morning: official opening of the Congress.
Afternoon: excursion to Villa d'Este (Lake Como); tea.
Evening: free.
For the Ladies: Morning: free.
Afternoon: excursion to Villa d'Este by motor-coach; tea.

Monday, September 18:
Morning: session of the Congress.
Afternoon: visit to the Triennial Exhibition of Modern Decorative Art and Architecture.
For the Ladies: Morning: sightseeing Milan by motor-coach.
Afternoon: visit to the Triennial Exhibition.

Tuesday, September 19:
Morning: session of the Congress.
Afternoon: reception.
For the Ladies: Morning: excursion to the Certosa of Pavia.
Afternoon: reception.

Wednesday, September 20:
Morning: visit to the "Ceramica Italiana di Laveno" (Lake Maggiore).
Evening: dinner at Stresa (Lake Maggiore).
For the Ladies: Morning: excursion to Stresa.
Evening: dinner, return to Milan.

Thursday, September 21:
Morning: closing of the Congress.
Afternoon: visit to "F. I. L. & Ceramica Lombarda."
Evening: leave for Venice.
For the Ladies: Morning: visit to the Sforzesco Castle.
Evening: leave for Venice.

Friday, September 22 (Venice):
Morning: visit to Murano Works.
Afternoon: free.
Evening: dinner.
For the Ladies: Morning: visit to the Town.
Afternoon: free.
Evening: dinner.

Saturday, September 23:
Morning: visit to Porto Marghera.
Afternoon: at 2 P.M. leave for Florence.
Evening: arrival to Florence.
For the Ladies: Morning: excursion to Murano and visit to an ancient and famous School of laces.
Afternoon: leave for Florence.

Sunday, September 24: free.

Monday, September 25:
Morning: visit to "Società Ceramica Richard Ginori" of Doccia.
Evening: dinner.
For the Ladies: Morning: excursion to Fiesole.
Evening: dinner.

Tuesday, September 26: end of the Congress.

For explanation and information write to Secretariato Generale del Congresso Internazionale del Vetro e della Ceramica, Via S. Maria Fulcorina, 17, Milano (108).

BUYERS' GUIDE

A

Abrasives (Alundum-Crystolon)
Norton Co.

Alexite (Refractory Products)
Carborundum Co.

Alumina (Hydrate and Calcined)
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Pennsylvania Salt Mfg. Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Aluminum Oxide (Fused)
The Exolon Co.
The Vitro Mfg. Co.

Alundum (Refractory Products)
Norton Co.

Ammonium Bifluoride
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Ammonium Carbonate
Ceramic Color & Chemical Mfg. Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Antimony Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

B

Ball Mills
McDanel Refractory Porcelain Co.

Ball Mills (Laboratory Type)
Ceramic Color & Chemical Mfg. Co.

Barium Carbonate
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Batts
Carborundum Co. (*"Carbofrax Alexite"*)
Norton Co. (*Alundum Crystolon*)

Bitstone
Potters Supply Co.

Blocks (Refractory)
Carborundum Co.
Norton Co.

Borax
American Potash & Chemical Co.
Drakenfeld & Co., B. F.
Pacific Coast Borax Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Borax Glass
Pacific Coast Borax Co.

Boric Acid (Anhydrous)
Pacific Coast Borax Co.
The Vitro Mfg. Co.

Boric Acid (Crystal, Granular, or Powder)
American Potash & Chemical Co.
Drakenfeld & Co., B. F.
Pacific Coast Borax Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Bricks (Refractory)
Carborundum Co. (*"Carbofrax Alexite"*)
Norton Co.

C

Carbofrax (Refractory Products)
Carborundum Co.

Carbolon (Refractory Products)
The Exolon Co.

Carbonates (Barium, Lead)
Ceramic Color & Chemical Mfg. Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Caustic Soda
Ceramic Color & Chemical Mfg. Co.
Pennsylvania Salt Mfg. Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Cements
Carborundum Co.

Ceramic Chemicals
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Metal & Thermit Corp.
The Roessler & Hasslacher Chemical Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Chromium Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Clay (Ball)
Ceramic Color & Chemical Mfg. Co.
Hammill & Gillespie, Inc.
Kentucky-Tennessee Clay Co.
Paper Makers Importing Co.
Potters Supply Co.
The Roessler & Hasslacher Chemical Co.
Spinks Clay Co., H. C.
The Vitro Mfg. Co.

Clay (China)
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Edgar Brothers Co.
Hammill & Gillespie, Inc.
Paper Makers Importing Co.
The Vitro Mfg. Co.

Clay (Electrical, Porcelain)
Ceramic Color & Chemical Mfg. Co.
Edgar Brothers Co.
Kentucky-Tennessee Clay Co.
Paper Makers Importing Co.
Spinks Clay Co., H. C.
The Vitro Mfg. Co.

Clay (Enamel)
Ceramic Color & Chemical Mfg. Co.
Edgar Brothers Co.
Kentucky-Tennessee Clay Co.
Metal & Thermit Corp.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Clay (Fire)
Edgar Brothers Co.
Kentucky-Tennessee Clay Co.
Paper Makers Importing Co.
Potters Supply Co.

BUYERS' GUIDE (continued)

Clay (German Vallendar)
Ferro Enamel Corp.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Clay Miners
Edgar Brothers Co.
Kentucky-Tennessee Clay Co.
Paper Makers Importing Co.
Spinks Clay Co., H. C.

Clay (Potters)
Paper Makers Importing Co.
Spinks Clay Co., H. C.

Clay (Sagger)
Edgar Brothers Co.
Kentucky-Tennessee Clay Co.
Paper Makers Importing Co.
Potters Supply Co.
Spinks Clay Co., H. C.

Clay (Wad)
Kentucky-Tennessee Clay Co.
Potters Supply Co.
Spinks Clay Co., H. C.

Clay (Wall Tile)
Kentucky-Tennessee Clay Co.
Paper Makers Importing Co.
Spinks Clay Co., H. C.

Clocks (Gauge Board)
Ferro Enamel Corp.

Cobalt Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Colors
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Cornwall Stone
Hammill & Gillespie, Inc.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Cornwall Stone (Imported)
The Roessler & Hasslacher Chemical Co.

Crucibles (Filter, Melting, Ignition)
Norton Co.
Potters Supply Co.

Crystolon (Refractory Products)
Norton Co.

D

Decorating Supplies
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Drying Machinery
Ferro Enamel Corp.

E

Electrical Porcelain
Paper Makers Importing Co.

Enameling Equipment (Complete)
Chicago Vitreous Enamel Products Co.
Ferro Enamel Corp.
Porcelain Enamel & Mfg. Co.

Enameling Furnaces
Carborundum Co. (*Carboradiant*)
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
Norton Co.
Porcelain Enamel & Mfg. Co.

Enameling Iron (Sheet)
American Rolling Mill Co.

Enameling Muffles
Carborundum Co. (*Carbofrax*)
Norton Co. (*Alundum*)

Enameling (Practical Service)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
Porcelain Enamel & Mfg. Co.
The Vitro Mfg. Co.

Enamels
Ceramic Color & Chemical Mfg. Co.
Metal & Thermit Corp.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Enamels (Porcelain)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
Metal & Thermit Corp.
Porcelain Enamel & Mfg. Co.
The Vitro Mfg. Co.

Equipment (Porcelain Enameling)
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
Porcelain Enamel & Mfg. Co.

Exolon (Refractory Products)
The Exolon Co.

F

Feldspar
Ceramic Color & Chemical Mfg. Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Fire Brick
Carborundum Co.
Norton Co.

Flint
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Flint Pebbles
Ferro Enamel Corp.

Floors (Non-Slip)
Norton Co.

French Flint
Paper Makers Importing Co.

Frit
Ceramic Color & Chemical Mfg. Co.
Ferro Enamel Corp.
Porcelain Enamel & Mfg. Co.
The Vitro Mfg. Co.

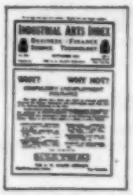
BORAX *Guaranteed 99½%–100% Pure* **BORIC ACID**

Select the Brand which has back of it years of *successful use* by experienced Ceramists

Pacific Coast Borax Co., New York

Chicago **Los Angeles**

Up-To-The Minute Information



To find the best articles upon business, financial, technical, chemical, or engineering subjects consult the INDUSTRIAL ARTS INDEX in your nearest Public, Special or College library.

It is a monthly subject index to the contents of more than 200 important periodicals including JOURNAL OF AMERICAN CERAMIC SOCIETY. Previous bound, cumulated volumes index the contents of principal business magazines for the past 20 years.

The library will probably have just the magazines you wish, new or old. If not, we can supply them promptly and reasonably.

Periodicals Department

THE H. W. WILSON COMPANY

Compilers and publishers of indexes to periodicals

950-972 University Ave. New York City

Numerical Documentation

THE ANNUAL TABLES OF CONSTANTS (A.T.C.)

AND NUMERICAL DATA

Chemical, Physical, Biological, and Technological

collect, classify and publish, since 1910, everything in Pure and Applied Natural Sciences capable of being expressed by a number.

(For the period 1910–1929) the **A.T.C.** *complete* and (since 1928) *continue* the International Critical Tables (I. C. T.)

The **A.T.C.** are absolutely necessary to all scientists.

They represent
the only one complete documentation—the most inexpensive—the easiest to consult
owing to an *Index* systematically arranged which enables one to locate *at once* the data required

For any information—any specimen—any volume on free examination

Apply immediately to

Canada and U. S. A.
The McGraw-Hill Book Company, Inc.
370 Seventh Avenue
New York, N. Y.

Other Countries
M. C. MARIE
9, rue de Bagneux
Paris VI^e^ France

Volumes published: 1st Series—I to V—1910–1922 (5382 pages) and Index (382 pages)
2nd " VI to IX—1923–1929 (7884 pages) and Index to Vol. IX (124 pages)

Specimens: Reprints of the following sections are sent free of charge; Spectroscopy—Electricity, Magnetism, and Electrochemistry—Radioactivity—Crystallography, and Mineralogy—Biology—Engineering and Metallurgy—Colloids—Wireless—Photography—Geophysics—Combustible Gaseous Mixtures, Powders and Explosives.

English versions: Beginning with Volume VII, all explanations to the tables are given in both English and French.

(When writing to advertisers, please mention the JOURNAL)

BUYERS' GUIDE (continued)

Furnace
Carborundum Co. (*Carboradiant*)
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
Porcelain Enamel & Mfg. Co.

G

Glaze and Body Spar
Ceramic Color & Chemical Mfg. Co.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Glazes and Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld & Co., B. F.
Ferro Enamel Corp.
Porcelain Enamel & Mfg. Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Glaze Spar
Ceramic Color & Chemical Mfg. Co.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Gold
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Grinding Wheels
Norton Co. (*Alundum Crystolon*)

H

Hearths
Carborundum Co.
(*Carbofrax* heat treating)
Norton Co. (*Crystolon*)

Hearths (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.
Norton Co.

I

Iron (Enameling)
American Rolling Mill Co.

K

Kaolin
Ceramic Color & Chemical Mfg. Co.
Edgar Brothers Co.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Kilns (China, Decorating)
Drakenfeld & Co., B. F.

Kryolith
Pennsylvania Salt Mfg. Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

L

Leeds (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.

Linings (Furnace Refractory, Block Refractory Plate, Brick and Tile)
Carborundum Co.
Norton Co.

M

Magnesia (Sintered, Calcined)
The Exolon Co.
Norton Co.

Magnesite
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Manganese
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Metals (Porcelain Enameling)
American Rolling Mill Co.

Minerals
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Muffles (Furnace)
Ferro Enamel Corp.
Carborundum Co. (*Carbofrax*)
Norton Co.

Mullite (Artificial)
The Exolon Co.

Muriatic Acid
Pennsylvania Salt Mfg. Co.

N

Nitrates (Cobalt, Sodium)
Ceramic Color & Chemical Mfg. Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

O

Opacifiers
Ceramic Color & Chemical Mfg. Co.
Metal & Thermit Corp.
The Roessler & Hasslacher Chemical Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Oxides
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Ferro Enamel Corp.
Metal & Thermit Corp.
Pennsylvania Salt Mfg. Co.
The Roessler & Hasslacher Chemical Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

P

Pins
Potters Supply Co.

Porcelain Enameling Service (Practical)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
Porcelain Enamel & Mfg. Co.
The Vitro Mfg. Co.

Porcelain Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
Porcelain Enamel & Mfg. Co.
The Vitro Mfg. Co.

BUYERS' GUIDE (continued)

Potash (Carbonate)
Ceramic Color & Chemical Mfg. Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Pyrometer Tubes (Refractory and Hard Porcelain)
McDanel Refractory Porcelain Co.

R

Refractories
Carborundum Co.
The Exolon Co.
Norton Co.

Refractory Materials
Carborundum Co.
The Exolon Co.
Norton Co.

Rutile
Ceramic Color & Chemical Mfg. Co.
Metal & Thermit Corp.
The Roessler & Hasslacher Chemical Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

S

Saggers
Carborundum Co.
Norton Co.
Potters Supply Co.

Selenite of Sodium
Drakenfeld & Co., B. F.
The Vitro Mfg. Co.

Selenium
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Sheets (Enameling Iron)
American Rolling Mill Co.

Silica (Fused)
The Exolon Co.

Silicate of Soda
Ceramic Color & Chemical Mfg. Co.
Philadelphia Quartz Co.
The Vitro Mfg. Co.

Silicon Carbide
The Exolon Co.
Norton Co.

Silicon Carbide Firesand
The Exolon Co.

Sillimanite (Synthetic)
The Exolon Co.

Slabs (Furnace)
Carborundum Co.
Norton Co.

Smelters
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
Porcelain Enamel & Mfg. Co.

Soda Ash
Ceramic Color & Chemical Mfg. Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Sodium Antimonate
Ceramic Color & Chemical Mfg. Co.
Metal & Thermit Corp.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Sodium Fluoride
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Spar
Ceramic Color & Chemical Mfg. Co.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Spurs
Potters Supply Co.

Stilts
Potters Supply Co.

Sulphuric Acid
Drakenfeld & Co., B. F.
Pennsylvania Salt Mfg. Co.

T

Talc
Hammill & Gillespie, Inc.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.

Tanks (Pickle)
Ferro Enamel Corp.

Tile (Refractory)
Carborundum Co. (*Carbofrax*)
Norton Co.

Tile (Wall)
Ferro Enamel Corp.
Paper Makers Importing Co.

Tin Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Metal & Thermit Corp.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Titanium
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Titanium Oxide
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Tubes (Insulating)
McDanel Refractory Porcelain Co.
Norton Co.

Tubes (Pyrometer)
McDanel Refractory Porcelain Co.
Norton Co.

W

Wet Enamel
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
Porcelain Enamel & Mfg. Co.
The Vitro Mfg. Co.

Whiting
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.

Z

Zirconia
Ceramic Color & Chemical Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

TRADE MARK
Pyrometer Tubes—Protection Tubes—Combustion Tubes
McDanel Refractory Porcelain Company
Beaver Falls, Pennsylvania
UNUSUAL · SHAPES · OUR · SPECIALTY
(When writing to advertisers, please mention the JOURNAL)

Do you buy Ceramic Materials as you buy NAILS?

TAM OPAX

A nail is a nail! But there is a difference in opacifiers. Actual results obtained thru mill addition of Opax in leading plants in the Enamelling industry prove its superiority.

Have you stopped to consider what Opax's Uniformity means to you in terms of lower manufacturing costs, for example? How the use of Opax makes whiter enamels and glazes, reduces your discards and recoats? Add the fact that Opax is easier to manage, has more opacifying power . . . is absolutely inert, irreducible, non-poisonous . . . stabilizes your light colors...then you have a powerful weapon to meet the demand for lower prices and higher quality ware in 1933.

TAM ENAMEL FRITS

Write for a **TAM** *Engineer*

THE TITANIUM ALLOY MANUFACTURING CO.

CERAMIC MATERIALS DIVISION

General Offices and Plant

NIAGARA FALLS, NEW YORK, U. S. A.

Executive Offices:

111 Broadway, New York City

(When writing to advertisers, please mention the JOURNAL)

ALPHABETICAL LIST OF ADVERTISERS

	Page
American Potash & Chemical Corp.	5
American Telephone & Telegraph Co.	4
Ceramic Color & Chemical Mfg. Co.	5
Chicago Vitreous Enamel Product Co.	14
Drakenfeld & Co., B. F.	Inside Front Cover
Du Pont de Nemours & Co., E. I., Inc.	Inside Back Cover
Edgar Bros. Co.	2
Edgar Plastic Kaolin Co.	2
Exolon Co.	6
Ferro Enamel Corp.	5
Hammill & Gillespie, Inc.	15
Journal of the Society of Glass Technology	2
Kentucky-Tennessee Clay Co.	1
McDanel Refractory Porcelain Co.	11
Metal & Thermit Corp.	Outside Back Cover
Norton Co.	1
Pacific Coast Borax Co.	9
Paper Makers Importing Co.	6
Philadelphia Quartz Co.	14
Porcelain Enamel & Mfg. Co.	15
Potters Supply Co.	15
Professional Directory	14
Roessler & Hasslacher Chemical Co.	Inside Back Cover
Spinks, H. C., Clay Co.	14
Tables Annuelle de Constantes & Donnees Numeriques	9
Titanium Alloy Mfg. Co.	12
Wilson, H. W., Co.	9

(When writing to advertisers, please mention the JOURNAL)

Uniform Enamels

EVERY bag of Lusterlite frit is uniform in grain size, uniformly free of moisture and uniform in weight. Exacting tests of raw materials and controlled manufacturing processes make possible the standardization of shop practice in the enameling plant and minimize the possibility of variation in the finished product.

CHICAGO VITREOUS ENAMEL PRODUCT CO.
Cicero Illinois

FOR BONDING Abrasive Wheels

SKILLED wheel manufacturers have long relied on "J" Brand, one of P.Q.'s 33 grades. It permits of rapid production of wheels sufficiently resistant to water to be run wet.

Your silicate of soda literature should include "Silicate of Soda in the Ceramic Industries." Send for a free copy.

PHILADELPHIA QUARTZ CO.
General Offices and Laboratory
121 S. THIRD ST., PHILADELPHIA
Chicago Office: 205 W. Wacker Drive

PROFESSIONAL DIRECTORY

THE SHARP-SCHURTZ CO.
Chemists for the Ceramic Industry
We have fully equipped laboratories at
Lancaster, Ohio, U. S. A.

Emerson P. Poste
Consulting Chemical Engineer
Analyses: Ceramic Raw Materials and Products, Fuels, Iron and Steel, etc.
Special Investigations: Physical and Chemical Tests on Enamel, etc.
99 Market St., Box 4051,
Chattanooga, Tenn.

Mr. Ceramist—

We have { *The Clay*
The Facilities
The Experience

H. C. SPINKS CLAY CO.
Newport, Ky.

PEMCO

PORCELAIN ENAMEL

For:
REFRIGERATORS
RADIO RESISTORS
BUTCHERS' FIXTURES
STOVES—Gas, Electric, Coal
WASHING MACHINE TUBS
WALL AND ROOFING TILE
AUTOMOBILE MANIFOLDS
BARBERS' SUPPLIES
SANITARY WARE
REFLECTORS
TABLE TOPS
NOVELTIES
SIGNS

ALWAYS CONSULT

PORCELAIN ENAMEL & MFG. CO.
PEMCO
Eastern and Pemco Aves.
BALTIMORE · MARYLAND
U·S·A·

Since 1848
Importers of

ENGLISH CHINA CLAYS
ENGLISH BALL CLAYS
CORNWALL STONE
TALC (STEATITE)

Dependable Qualities of Ceramic Materials for all Branches of the Industry

HAMMILL & GILLESPIE, INC.
225 Broadway
New York

Ceramic Service? We Give It

We Manufacture—

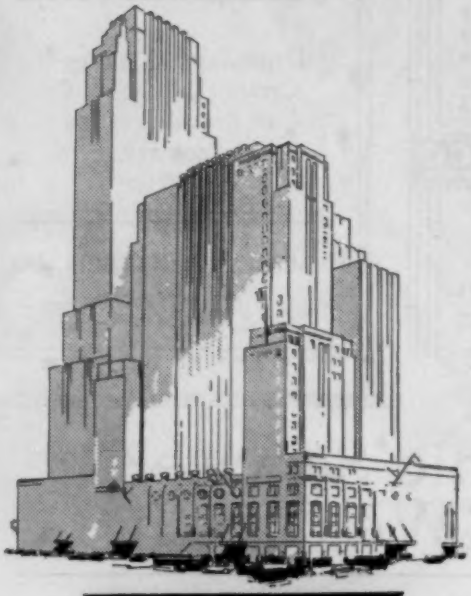
Pins
Stilts
Thimbles
Spurs
Saggers
Crucibles
Tile for Decorating Kilns

We Sell—

Ball Clay
Sagger Clay
Wad Clay
Ground Fire Clay
Bitstone
Fire Brick
Imported Paris White
Domestic Whiting

THE POTTERS SUPPLY COMPANY
EAST LIVERPOOL, OHIO

Netherland Plaza Headquarters for 36th Annual Meeting of American Ceramic Society February 11-16, 1934



The enthusiastic verdict of thousands of "conventioneers," has established the Netherland Plaza as *the* convention hotel for the Middle West . . . and Cincinnati as *the* convention city.

Not merely upon a feature or two does this fame rest! It rests on the *completeness* of the Netherland Plaza, the luxury and adequacy of its comfort, the quality of its food, the atmosphere of *class* . . . the general feeling that here is something different —something away from standardized "line-production" service. The few particulars listed below are indicative of what you may expect when you register at the Netherland Plaza

RATES FROM $3.00

1—26 private dining rooms of all periods.
2—5 separate restaurants. Prices meet all requirements.
3—Three entire floors of sample rooms . . . any size you want.
4—Hall of Mirrors for conventions and functions. Exhibit space in connection.
5—Sound pictures for entertainment and convention purposes.
6—1100-car electric parking garage in building.
7—All outside rooms with bath and shower, radio and running ice water. Twin beds with twin baths.
8—Six to nine room Parisian studio apartments.

Netherland Plaza

JOSEPH REICHL PRESIDENT AND MANAGING DIRECTOR

CINCINNATI

Meet New Demands in Glassware by using

MINPRO CHEMI-TROLD GLASSPARS

REG. U. S. PAT. OFF.

Strength! . . . One of the major requirements of the new glassware which has come into demand almost overnight. Bottles, glasses, jars—all must be made to withstand rough handling; they must not lose brilliancy in storage. Glass manufacturers recognize that the selection of the proper raw materials is of utmost importance in securing these qualities.

Minpro "Chemi-Trold" Glasspars, as produced by the United Feldspar Corporation, are ideal products for use in the manufacture of this new glassware. The alumina content in these spars gives high mechanical, tensile and crushing strength to the finished bottle or jar. Also, it increases the brilliancy and lustre and resists the weathering and atmospheric attacks which sometimes develop when such containers are stored.

Minpro Semi-Granular Glasspar is the newest of the Glasspars produced by the United Feldspar Corporation, and is especially adapted for use in the manufacture of beer bottles and similar containers.

- **Minpro Granular Glasspar.** A dustless, free-flowing product. All through a 20 mesh. Residue 85–100% on 200 mesh screen. Average iron content 0.05–0.06%. Iron diamagnetically separated.
- **Minpro Semi-Granular Glasspar.** All through a 20 mesh. Residue 62–85% on 200 mesh screen. Average iron content 0.10%.
- **Minpro Ordinary 20 Mesh Grinding.** All through 20 mesh. Residue 42–62% on 200 mesh screen. Average iron content 0.10%.

These three types of grindings are all produced under a patented process of strict chemical control (U. S. Pat. 1,855,115). They can be furnished in all grades in accordance with the commercial standard C.S. 23–30 issued by the Bureau of Standards of the U. S. Department of Commerce.

Write for samples and further information on Minpro Glasspars.

DU PONT

E. I. Du PONT De NEMOURS & CO., INC.

The R. & H. Chemicals Dept., Wilmington, Del.

District Sales Offices: Baltimore, Boston, Charlotte, Chicago, Cleveland, Kansas City, Newark, New York, Philadelphia, San Francisco

Sole Selling Agents for UNITED FELDSPAR CORPORATION

M and T

Tin Oxide

for a brilliant, rich, white glaze

Brilliant and rich . . . snow white . . . free from specks and discolorations . . . that's the kind of glaze you want, and that's the kind you always get with M and T Tin Oxide.

Hundreds of firms, including many of the largest in the country, are definitely committed to the exclusive use in glazes of M and T tin oxide. These firms find that by the use of M and T tin oxide they are assured glazes which are always a rich, pure white . . . always free from specks and discolorations . . . always remarkably brilliant.

That is why the exclusive use of M and T Tin Oxide is a rule in such plants.

Metal & Thermit Corp.

CERAMIC DEPARTMENT

HOMER F. STALEY • MANAGER
R. R. DANIELSON • DIRECTOR OF RESEARCH
120 BROADWAY, NEW YORK CITY